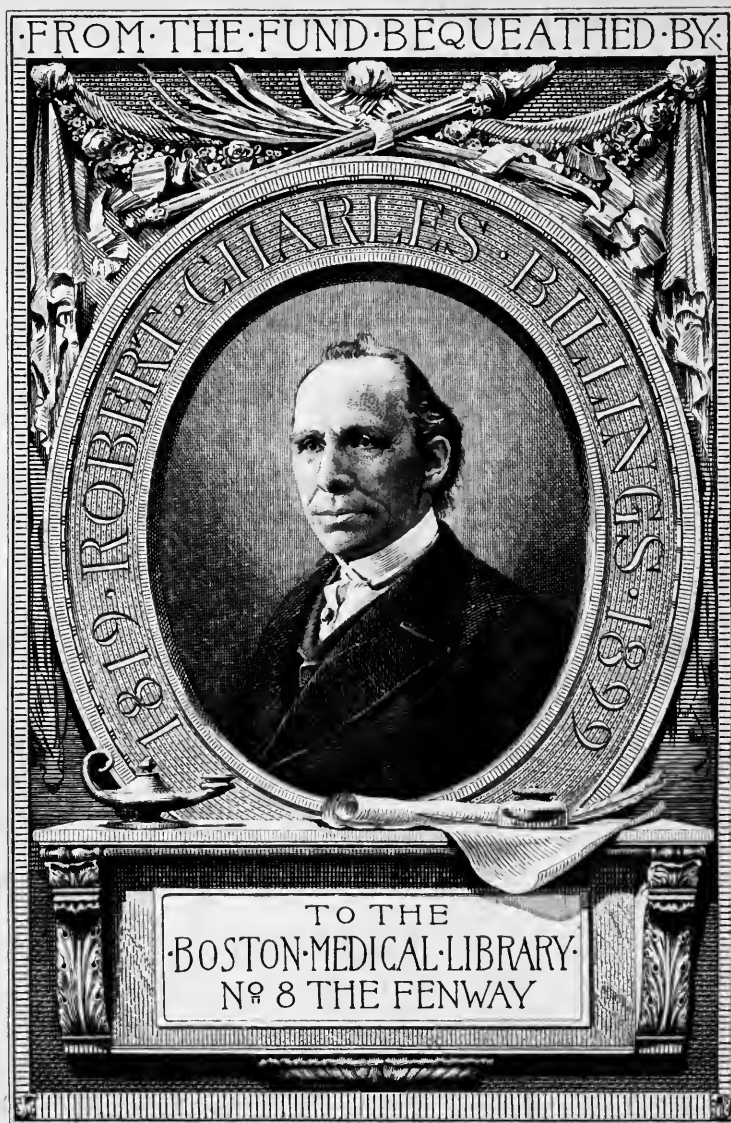


THE
SIMPLICITY OF LIFE.

RALPH RICHARDSON, M.A., M.D.



THE
SIMPLICITY OF LIFE.

THE
SIMPLICITY OF LIFE

AN INTRODUCTORY CHAPTER

TO

PATHOLOGY

BY

C
Ralph Richardson, M.A., M.D.

FELLOW OF THE COLLEGE OF PHYSICIANS OF EDINBURGH.

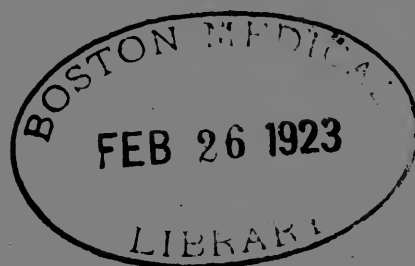
*"Whoever thinks a faultless work to see
Thinks what ne'er was, nor is, nor e'er shall be."
Expect not such, my friends, from me.*

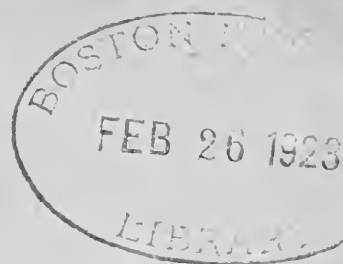
LONDON:
H. K. LEWIS, 136 GOWER STREET.

MDCCCLXXIII.

F.A. 462.

20440Bi.50





ESSAY
ON
THE SIMPLICITY OF LIFE.

IN preparing materials for an edition of Fletcher's *Vague Terms*. Pathology, the use of vague and uncertain terms in describing both healthy and morbid phenomena, has constantly thrown obstacles in the way of treating the subject.*

Before discussing the clear and lucid theory of Fletcher, who reduced all morbid actions to one, and the same law or general expression, it appears desirable that the terms which Fletcher employs when speaking of vital action should be explained: and as vital action implies life this subject first demands attention. *Fletcher's Theory.*

For pathology being merely a branch of physiology, any doctrine of the former must be consistent with the more general laws of vital action, or with physiology. "Health and disease are the same states differing only in degree." All pathology then must be consistent with our knowledge of the nature of vital actions in health, or physiology in its more restricted sense.† *J. Brown's Axiom.*

Notwithstanding the teaching of John Brown in the *Nature of Life.*

* NOTE 1, APPENDIX.

† NOTE 2, APPENDIX.

the last century, and the clear and precise explanation of Fletcher in the early part of this, the nature of life is still a subject of dispute.

The following remarks on this subject, consist merely of some extracts from Fletcher's *Physiology*, and a few old notes from his lectures, which, when brought together equally show the error of the physical and vital theories of life, and explain its intrinsic nature in all its simplicity.

At the present time there are three principal theories of life, the physical, the vital, and the natural.

Huxley. The physical supported by Professor Huxley, who considers "physiology a complex branch of mere physics" and that "vitality is a nonsensical fiction," because "it can neither be weighed, measured, nor conceived to exist." "Life therefore is a form or mode of ordinary force."*

† Beale. Beale who advocates the vital doctrine considers "life to be a power, force, or property of a special and pecu-

* "Irritability is synonymous with vitality, and signifies the susceptibility of undergoing, on the application of a stimulus, any change which, as not strictly either mechanical or chemical, is characteristic of organised beings." Fletcher's *Physiology*, pt. ii. p. 52.

"By irritability we merely imply the possibility of the powers of a protoplasmic mass being called into play by some agent external to itself, and of these the simplest and most efficient is heat." On Protoplasm, *Med.-Chir. Review*, April, 1872.

† *Mystery of Life*, p. 2.

liar kind, temporarily influencing matter and its ordinary forces, but entirely different from, ^{and} in no way ~~and~~ correlated with, any other."

The natural theory, that life consists in the "sum of the actions of organized beings" was advanced by John Brown in 1770, and systematized, and enforced, by Fletcher in 1826, and published in his *Physiology* ten years afterwards.

Brown's
Theory of
Life.

Fletcher.

He taught that vitality was the property that characterises organised beings. It results from their organic structure, and when acted on by certain external powers gives rise to actions not strictly mechanical, or chemical and which are hence styled vital, and in which actions, life consists.

Vitality.

After these three theories of life have been discussed, Mayer's theory and his notion of the equivalence of Force will also receive a few words of explanation.

Mayer.

Had Prof. Huxley, Sir W. Gull, Dr. Lionel Beale, and Mayer used the words, Life, Vitality, Force, Power, and Organization, in the sense they are used by grammarians and logicians, they would have come much more nearly to an agreement with Brown and Fletcher.

Use of Words.

In discussing the nature of Life it is most important to keep steadily in mind the distinction between a property, a power, and an action.

Fletcher's
Property.

A property signifies only a susceptibility of motion,

Power.

* NOTE 3, APPENDIX.

† NOTE 4, APPENDIX.

Action. a power only a means by which this susceptibility may be called into action, while an action designates the phenomena resulting from the two in co-operation.

Properties. By a property is understood a faculty, quality, or capability, such as irritability, sensibility, vitality, combustibility, elasticity, and so forth ; all of which signify merely a susceptibility of excitement.

Power. A power is variously understood as a stimulus, force, or agent, such as caloric, light, electricity, air, aliment, attracting force, &c., all of which signify a means whereby this susceptibility may be called into action.

Action. While the last, like irritation and sensation, life or vital action, combustion, reaction, gravitation, designate the phenomena resulting from the two in co-operation, it would appear superfluous to notice these distinctions, had they not been so frequently lost sight of not only by the οἱ πολλοί but even by authors of merited celebrity.*

Confusion of
Property and
Action.

* Every one must have observed the confusion of these terms in common conversation, and how a quality is at once assumed on seeing the action naturally resulting from it.

Thus at a cricket match, one of the spectators seeing "short-leg" make "a splendid catch" six feet from his station, remarks, what *activity* that "field" displays, when it is obvious that "short-leg" has only displayed to our sight, active motion or action in taking the fast ball, and his *activity* is a mere inference of the mind. Apart from "short-leg" in the concrete, this abstract quality of *activity* could be neither "weighed, measured, made evident to the senses, nor scientific

A certain analogy pervades all the actions of all the natural objects of which man can take cognizance; whether such motions be gravitation, chemical union, or living action or Life.

Analogy of
Actions.

For every action, mechanical, chemical, or vital, there is implied an object with mobility, some extrinsic power to act on this property, and some change of condition or state in which such motion consists.*

It is from observing the effect of the ordinary powers or forces of nature, light, heat, electricity, air, water, &c., in calling into play vital equally with mechanical and chemical phenomena, that the physical doctrine of life has originated, and it is the contemplation of the very different reactions of organised from inorganic matter when acted on by the same forces or powers that has influenced Beale in forming his vital doctrine, which

Same powers
produce differ-
ent efforts.

cally proved to exist." Yet our belief in "short leg's" *activity* is as strong as in the color of his hat band.

* As we recognise matter only by its properties, and as we know these properties only by their effects upon the senses, our belief in any of the properties of matter is strong in proportion to the impression they make upon our minds; and without implying a separate existence to these properties we still use substantive terms to express these abstract qualities, whether they be combustibility, elasticity, solubility, irritability, or vitality, not one of which can be "weighed, measured, or made obvious to the senses." It should be remembered, however, that a property of one body may act as a power or stimulus to another—the pungency of snuff may stimulate the nose.

Properties
of
Matter.

however, differs very slightly, if at all, from the old doctrine of the Vital Principle.

The difference of these actions does not depend upon the different forces which produce them, but upon the different properties of the matters, the subject of such actions.

Huxley.

Professor Huxley considers that "the assumption of a special vital force (*quality*) is illogical and unscientific," (*Physical basis of Life*). "The mechanical actions of the body are governed by the same laws which regulate similar changes of energy (*actions*) in the inorganic world." "Where matter is, there force (*properties*) must be, showing itself in motion, tension and resistance."*

* That the mechanical actions of the body follow the laws of mechanics, and the chemical actions of the body those of affinity, is a mere truism. The question remains, are there any actions of living beings not strictly mechanical or chemical, and which are therefore called vital?

To speak of "changes of energy" or force, and that "force shows *itself* in motion" is decidedly "illogical and unscientific." A force or power can produce no effect unless in co-operation with some matter having a susceptibility adapted to such force, and by its reaction giving to our minds the notion of force. Professor Huxley talks of "changes of energy;" what is meant by that word is not very obvious. If energy be only another name for power, force, or vigour, we have no means of ascertaining such change. The power of the sun is as great, whether he shines on the ocean, on the desert, or on the meadow; but his power of exciting vegetative growth is only to be seen on the latter.

The attractive power of the particles of water to each other so as

“When hydrogen and oxygen” says Professor Huxley, “are mixed in certain proportions, and an electric spark is passed through them, they disappear, and a quantity of water, equal in weight to the sum of that of the two gases, appears in their place. Here it is obvious that the imponderable electric spark is not an intrinsic power or force appertaining to oxygen or hydrogen, but an extrinsic force,” (acting on their natural affinity, or in other words, exciting their propensity to form a chemical union) “and necessary to their conversion from a state of gas to a state of water,” or as we should more properly say, necessary to the display of one of their characteristic actions, from which our knowledge of their characteristic properties is deduced.

Huxley's
simile.

In the same way a grain of wheat may, like the gases, remain without alteration for ever, but if exposed to the power of Light, Heat, Air, Moisture and some salts, will display sensible changes of condition. These stimuli not being intrinsic powers of the seed, but extrinsic forces necessary to call into action the intrinsic and

Vitality.

to form ice, is as great at Senegambia as at Mount St. Bernard, but it never shows itself at the former, and continually at the latter.

The sun, as seen from Switzerland and Senegambia, is the identical heavenly body, but its power of melting water is seldom seen at Mount St. Bernard, but always obvious in Senegambia, but is “the energy” of the sun “changed”?

What relations “mechanical actions” have to “changes of energy” is simply incomprehensible.

characteristic properties of the grain of wheat, these characteristic qualities are called vitality.

Vitality and
Affinity.

If the seed above spoken of be deprived of its vitality by an electric spark, or heated to about 112° , and then be exposed to similar Light, Heat, Air, moisture and some salts, instead of growth, there will occur putrefaction, or chemical action.

These stimuli are not intrinsic powers appertaining to the gluten and starch, of which the seed is composed, but extrinsic forces acting on the intrinsic properties of the dead grain of wheat, and exciting actions peculiar to matter having such properties.

These peculiar properties are called affinity.*

Beale.

Beale would say the seed had lost its "vital force," or "vital power," the influence of which accounts for the phenomena of living action,† but if so, it must at the same time have acquired a putrefactive power, or force,

Vital and
Chemical
Action.

* The phenomena of growth and of putrefaction of the grain of wheat are as dissimilar as any of the phenomena of Nature, and as each is caused by the same forces, it is obvious that the matter upon which these forces act must have different properties, or, in common language, be different in kind.

To say that the science of chemical and vital actions are branches of "mere physics" is to make mere physics into the old physiology or the universal science of nature, but this in no wise proves the identity of vital, of chemical, and of mechanical actions.

† NOTE 5, APPENDIX, from p. 53 of Beale's *Mystery of Life*.

the influence of which accounts for the chemical phenomena.*

When it is said that the actions of organized beings are peculiar and distinct from such as are unorganized, it is not meant that organized beings are exempt from all mechanical and chemical modes of action, but that the peculiar actions of organised beings are *sui generis*.†

Vital Actions
Peculiar.

* If intrinsic vital force be needful for vital action, intrinsic chemical force must be needed for chemical action, and intrinsic mechanical force for mechanical action. It is obvious that all forces acting in such a manner are extrinsic to the matters which display vital, chemical, or mechanical action, just as in Professor Huxley's example of the electric force which excited chemical action between the two gases.

What the grain of wheat (above spoken of) has lost, is its vitality, and it has acquired the property of putrefactibility or common chemical affinity.

Vitality is just as mysterious as, and no more so, than putrefactibility. Why, and wherefore, some matter should possess one quality and some another is equally unaccountable. To say that this last quality depends upon a certain aggregation of elements which always putrefies under favorable circumstances, is no explanation, as the why, and the wherefore, these elements when so associated should have these qualities, remains as before.

† Animals obey the laws of gravitation, and some of their actions are mechanical, and some of their constitutional actions are purely chemical, as digestion and the extrication of heat and production of cold; but the formation of the saliva, the gastric and pancreatic fluids and the bile, all from the same blood, are purely vital actions, and as dissimilar from any chemical, as these are from mechanical action.

Beale remarks that "it is absurd to expect that thoughtful persons

Beale.

Sir. W. Gull's
misuse of
terms.

To what a deplorable misuse of terms the advocates of the physical basis of life are driven, may be seen in the Harveian Oration of Sir W. Gull in 1870. He there remarks (page 12) "To begin with the lowest series of living things. There will probably be no hesitation in admitting that the vegetable kingdom is no more than *an expression* in a higher form of the terrestrial conditions, which even common experience proves to be in a general way necessary to vegetable life. An expression of conditions" !!!*

Again, at page 25, Sir W. Gull remarks, "Not to occupy time by recapitulating the arguments of the Bridgewater Treatises, which although written from another point of view, would equally prove this unity" (of organism of De Blainville). I cannot forbear asking you for one moment to consider again this organization of our bodies in relation to the earth we inhabit, and then will be convinced that vital phenomena are physical and chemical phenomena, simply by an authoritative assertion that they are so."

But the same extrinsic powers may excite each kind of phenomena.—If a piece of granite, a lump of salt and an eel be each thrown into a stream, they will each obey the law of gravitation; each is exposed to the solvent and stimulant powers of the heat, air and water in the stream, but they will each display different conduct, and we naturally infer the possession of different qualities: one has gravity and durability, the second gravity and solubility, and the third gravity and vitality; but gravity, durability, solubility and vitality are each equally beyond the reach of our perceptions.

* SEE NOTE 6 APPENDIX.

say if it be otherwise conceivable, but as the expression of the highest correlation of these external conditions.”

Sir W. Gull's
misuse of
terms.

All known vegetables therefore are merely an “*expression* of terrestrial conditions,” and the organism of the *genus homo* is an “*expression* of the highest correlation of these external conditions”; whatever that may mean.*

Again, at page 13, Sir W. Gull lays down the law, “That the forces exhibited in animal functions are those previously stored up in plants by assimilation, *is a fixed position in physiology*, and so far the operation of the law of life is plain.”†

An animal function is the action of an organ or apparatus, destined to some special purpose in the general economy of an organized being, and like every other action, supposes some matter with a susceptibility of acting, an extrinsic force adapted to act on this susceptibility, and the function or action resulting from their co-operation. The forces exhibited in the animal functions are like Professor Huxley's electric spark to the gas, not intrinsic qualities, but extrinsic powers, as Light, Heat, Electricity, Air, Moisture, Aliment, and so forth.

Function.

* Philosophers, when determined to reject the most obvious conclusions of common sense, employ language so ambiguously as to conceal the scope and meaning of their arguments. As Locke remarks, “it is as difficult to refute such men whose notions are thus unsettled as to dispossess of his home, a vagrant without a settled habitation.”

Locke.

† “Plants are the accumulators of the power which animals distribute and disperse.” *Lay Sermons*, 148, Huxley.

Sir W. Gull's
misuse of
terms.

Again, as forces are merely qualities of matter, and not themselves material, how such qualities can be *stored up* is inconceivable.

Animals assimilate their food, but not the pungency, solubility, cohesion, specific gravity, fluidity, &c., of their diet, all of which, however, may act as forces to excite digestion.

Again, when it is asserted that the powers of Light, Heat, and Electricity are stored up, it must be assumed that these powers are material, and capable of being stored up instead of being mere motions or vibrations of matter. They exist only in connection with some matter which displays these characteristic effects.*

At page 11, Sir W. Gull asserts that, "the organic processes in their entirety might be correlative of the lower forces." But an organic process is merely an organic action, and the only correlatives of every action are the extrinsic powers to, and the intrinsic qualities of, the subject of such action.

The "lower forces" if by that term is understood, Light, Heat, Electricity, Air, Aliment, Water, Condiments, &c., are undoubtedly correlatives in their quali-

* Sir William Gull, in his Harveian Oration, advocating the Physical basis of Life, describes the material bodies of animated beings as mere "*expressions of conditions*." So Max Muller in his essay on the Science of Language, which deals merely with vocal expressions, asserts that the science of language is a Physical Science. Page 9, edition of 1868.

ties of stimuli to vitality, and are hence one of the necessary conditions of Life, but as vitality differs from every known quality of inorganic matter, so vital action differs, not only in degree, but in kind, from every known physical action.*

Correlation of
Life.

Dr. Lionel S. Beale maintains his doctrine of vitality with much vivacity,† indeed with a degree of warmth that will appear inexplicable a dozen years hence.

Beale.

He asserts that "Life is a power, force, or property of a special and peculiar kind, temporarily influencing matter and its ordinary forces, but entirely different from, and in no way correlated with any of these."

* NOTE 7 IN APPENDIX, On the Nature of Vitality and its Correlative Power, from J. Fletcher.

† It is to be hoped that Professor Huxley will not object to the use of this term, Vivacity, as he has so captiously done to Vitality, because like all other abstract qualities, it "can be neither weighed, measured, made evident to the senses, nor can its existence be proved scientifically."

Dr. Lionel Beale, in his work on the Mystery of Life, p. 64, vivaciously remarks: "During the last twelve years, numerous facts elucidated in the course of careful microscopical investigations on the tissues of plants and animals, which have not been called in question, tend to establish upon a firm basis the doctrine of "Vitality," or at least indicate that the phenomena peculiar to living beings are due to the working of some "Special Power" capable of guiding and directing and arranging ordinary matter, but in no way emanating from, or correlated with, the ordinary material forces. I cannot but conclude from my investigations that the living is separated from the non-living by an impassable barrier"—("la nature semble faire un saut," Bonnet,

Beale's
remarks.

Beale. Beale's theory of Life being a "power influencing matter" is not distinguishable from the old vital principle.*

1762, quoted above by Fletcher)—by a gulf that will not soon be bridged over: that matter and its ordinary forces and properties belong to one category or order; and that creative power and will, design and mind and life, ought to be included in a very different order indeed." (*Matter and Spirit*, of Locke).

"In conclusion, I submit that the arguments advanced by Sir W. Gull and others, do not show that the opinion that life "is a power" entirely different from, and in no way correlated with, matter and its ordinary forces" is untenable. Neither can it be held that the reasoning advanced by him in any way justifies the acceptance of the hypothesis that *life is correlated force*. This physical doctrine restricts advance and retards scientific progress. On the other hand, the theory of "Vitality" helps us to explain many phenomena otherwise inexplicable at this time, while it is not incompatible with any of the truths of physical science. I am quite ready to be *taught*, but I cannot submit to be *forced* into confusion by force, while I retain vital power to resist."

Prichard. Dr. Prichard long ago remarked that the Vital Principle, if it could never untie a knot could cut through any number; and Dr. Lionel S. Beale calls upon this old and respectable though incomprehensible agent to explain every process in the animated economy for which he cannot otherwise account.

Ross. * Dr. James Ross, in a "Critique of Dr. Beale's Theory of Life," in the *Practitioner*, thus describes Beale's theory:

"Dr. Beale says that he attributes vital phenomena to 'vitality, or vital power or force, or to life.' Hence it may be inferred that he uses these words as synonymous terms for one and the same power. Let us ascertain, then, what are the attributes he assigns to it. From the title of his recent work, 'The Mystery of Life,' it is evident that he regards this power as a mysterious one: 'it is beyond the range of

Beale.

FROM
RUDIMENTS OF PHYSIOLOGY.

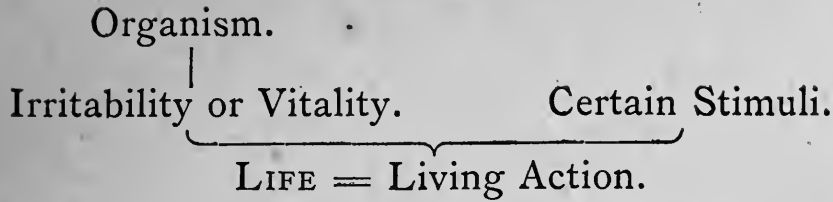
BY
JOHN FLETCHER, 1836.

It is in the sum of those actions of organized beings Nature of Life. which have been above described as fundamental, whether any others be added to them or not, that LIFE appears essentially to consist. Organism and life are, physical and chemical investigation, and cannot be rendered evident to the senses.' And it is not only a mystery, but a *special mystery* which presents itself nowhere in nature except in living beings: 'it is a power, force, or property of a special and peculiar kind, temporarily influencing matter and its ordinary forces, but entirely different from and in no way correlated with these.' This force, however, is not a property of matter, since 'it is essentially different in its actions from all acknowledged properties of matter.' It is not matter, since, as already quoted, it is a power 'temporarily influencing matter and its ordinary forces.' It is not mind, since 'life exists before brain and nerves, the instruments of mind, are formed.' But although this power is not mind, it possesses the distinguishing characteristic of mind, since it is an intelligent principle."

In his Oxford Lecture (1869) Beale, in discussing the nature of muscular motion, considers the act of contraction a function of the *non-living* part. This may be merely a different use of the word *living*, but to ordinary persons muscular action is the best proof and sign of the part being yet alive.

Nature of Life. under ordinary circumstances—in other words, under the application of the requisite stimuli—coincident, the commencement of the former producing generally that of the latter, while the cessation of the former gives rise always to that of the latter also ; and if we retrace all that has been said respecting each particular feature in the Structure of organized beings—their individuality and definite form and volume, the multiplicity of their distinct organs, the co-existence in them of solid and fluid parts each in a constant state of mutual conversion, and their specific chemical nature—we shall find that every thing relating to their Organism or Structure has a direct relation to their Life, or the Actions which they are to perform. Organism and Life then, in this sense of the latter term, may be described as standing in the relation indirectly of cause and effect to each other, the former giving rise essentially to the development of a certain property called Irritability or Vitality, which, when acted on by certain Stimuli, generally in more or less constant operation, produces those Actions in the sum of which Life consists. This relation then of the two may be represented by the following plan.

Dr. J. Bell Pettigrew mentions the movement of the cilia, the heart and hollow viscera after separation from an animal, as proofs of these parts being still living after such removal.—Edin. Med. Journal, Oct. 1872, p. 292.



This view of the matter however has not always, nor even till of late, generally been taken ; the Structure of organized beings having been admitted indeed to be identical with their Organism, but not their Actions with Life ; and while it has been allowed that this Organism and these Actions are commonly coincident, it has been denied that they stand, either directly or indirectly, in the relation of cause and effect to each other, both being described as dependent on Life as a substantial Principle. The following plan may represent this relation of Organism and Life.

Vital
Principle.

$\text{LIFE} = \text{Vital Principle.}$

}

Organization. (producing Organism) Living Action.

It is hence obvious that the word Life is employed in two very different acceptations, signifying sometimes merely that chain of peculiar actions above-described as characteristic of organized beings, the immediate conditions of which are to be sought for, partially at least, in a necessary result of organism ; and sometimes a substantial Principle—an Entity, whether material or immaterial*—which, entering certain aggre-

* It would not have been considered necessary to remind the student that the existence of an immaterial substance—of an *οὐσία*.

gations of matter, regulates as well their organization—whence results their organism—as all the other phenomena which they exhibit.† The questions then

ἀλλος, as well as a ὅλη— has never been regarded as an impossibility, had not some recent writers seemed to imply the reverse.

Mayo.

Dr. Bostock, for example, accuses Mr. Mayo, to the correctness of whose general phraseology he at the same time pays a merited compliment, with having controverted his own proposition in the very statement of it, where he says, “Mind and matter are logically distinct substances” (*El. of Physiology*, 1825, vol. i. p. 301). Whether they be so or not may be questioned; but it is at least certain that they may be so.

† In ancient times Life in the former of these senses was called by the Greeks Ζωή, and by the Romans *Vita*; in the latter, by the Greeks Ψυχή, and by the Romans *Anima*. We have unfortunately no single term by which to designate the supposed substantial Principle, if we employ the word Life to signify merely the chain of actions, and no one by which to designate the chain of actions, if we apply the word Life to the supposed substantial principle. We can do better however without a name for a Principle which pretty certainly has no existence, than for actions which certainly occur. In these two acceptations then the word Life, not only has two totally different meanings, but implies two totally different views of the subject at issue; but there is still a third acceptance in which the term is sometimes employed, distinct from both these meanings, but nevertheless quite consistent with the former of these views, the only difference consisting in this, that whereas the term, as used above, signifies Living action, it is employed in this new meaning to signify irritability or vitality—one of the conditions of this action. Such is the meaning attached to the word Life by Dr.

Elliotson.

Elliotson, who says of it that “it is used sometimes properly for

arise, 1st. What evidence have we of the existence of any such substantial Principle? and 2ndly. How far is it adequate, admitting its existence, to explain vital phenomena? * If we fail in establishing, both its existence, and its adequacy to produce the effects which have been ascribed to it, we must acquiesce in the pro-

Life-defini-
tion.

the power (property), sometimes improperly for the result." (*Human Physiology*, 1834, p. 31). In the mere application of a term however, where the proposition signified is the same, that must surely be the best which is the most usual; and as the term Vitality is by general consent appropriated to one of the conditions of living action, and the term Life to this living action itself, the employment of the term Life to signify vitality has only the effect of giving us two terms for the property, while it deprives us of any term at all for the result of it, and is calculated to give rise to a great deal of logomachia which might very well have been avoided. Let it not be imagined, however, that because in this instance the whole point in dispute hinges on the definition of a word, the same is the case in the two acceptations of the word Life previously proposed; for, while no difference of doctrine exists whether the term Life be used to signify living action or vitality, since both are parts of one doctrine, a fundamental difference of doctrine is conveyed by the acceptation of the word Life in the sense of Vital Principle, no such substance as this being in the former case admitted.

Vitality.

* It is a rule of the immortal Newton, of which we are aptly reminded by Dr. Prichard, in entering upon the present discussion, (*On the Vital Principle*, 1829) "Causas rerum naturalium non plures admitti debere, quam quæ et veræ sint, et earum *phænomenis explicandis sufficient*" (*Principia*, lib. iii).

Newton.

position first advanced, that Life is a mere abstract term used to denote the characteristic actions of organized beings resulting more or less immediately from their organism.

Vital
Principle.

First then with respect to the *Existence* of a Vital Principle, or of Life as a substance. The evidences commonly adduced in favour of this hypothesis hinge principally upon the presumed impossibility of explaining either the original organization of a living being, or its characteristic actions when organized, without this admission, and the incompatibility of the opposite opinion with a belief in a future state of existence :* on

* That Life is an *Ousia*, an Entity or a Substance, material or immaterial, resident in certain aggregations of matter, and the cause both of its organization, and of the characteristic actions which it afterwards performs, is the oldest opinion on the subject, having been entertained by almost all the ancient sects of philosophers. The notion of the existence of an Elementary Fire—the Soul of the world, the formative and conservative Power of all nature—descended from the Brahmins of India, through the renowned Hermes Trismegistus. Trismegistus, or Tot of glorious memory, and the Pastophori of ancient Egypt to Thales and Pythagoras, the former of whom studied at Memphis, and subsequently taught philosophy at Miletus, while the latter studied at Thebes, and taught afterwards at Crotona. It thus became the tenet of the numerous schools which, in later times, flourished in Greece and Italy—the Academic under Plato, the Peripatetic under Aristotle, the Stoic under Chrysippus, and so forth. By the “learned Theban,” indeed, this *Πῦρ καθάρσιον* of the Egyptians had its name changed to *Ψύσις*,

the degree of validity therefore of each of these alleged evidences it will now be necessary to say a few words.

while by Plato it was called for the first time $\Psiυχ\eta$, by Aristotle $\epsilon\nu\tau\epsilon\lambda\acute{\epsilon}\chi\epsilon\iota\alpha$, and by Chrysippus $\Pi\nu\epsilon\tilde{\upsilon}\mu\alpha$. Nor were the opinions of these and other celebrated philosophers, respecting the nature of this imaginary substance, less discordant than the names which they imposed upon it; some looking upon it, like the original propagators of the doctrine, as a kind of Fire, others as a kind of Air, or Ether, or Spirit—the Breath of life, &c.—and others again as merely a kind of Water (*Cicero's Tusc. Quæst. lib. i. § 9, 10*). But, whatever were its nature, this supposed substance actuating, as was believed, the Macrocosm or universe, of which it regulated all the motions in the capacity of Life or Soul of the world, was capable of being split or divided into innumerable portions, so that each individual Microcosm or organized being got a chip of it—a *Divinæ particula auræ*—and this, in quality of its proper Life, in like manner actuated and directed all its proceedings. This idea of the Vital Principle, in its character of Fire, has been immortalized by the story of Prometheus, who is said by the poets to have vivified his clay statues by a fragment of it stolen from the chariot of the sun; and a similar notion was embraced by all the early physicians. Thus by Hippocrates the human body is described as consisting, not merely of $\iota\sigma\chi\omicron\nu\tau\alpha$ and $\iota\sigma\chi\omicron\mu\epsilon\nu\alpha$, of which notice has been taken already, but of $\epsilon\nu\omicron\rho\mu\omicron\upsilon\nu\tau\alpha$ also, which seems to signify nearly the same thing, or the same nothing, as any one of the terms above specified—so much so, that Galen subsequently again employed, instead of it, the term $\pi\nu\epsilon\upsilon\mu\alpha\tau\alpha$, from Chrysippus. These $\pi\nu\epsilon\upsilon\mu\alpha\tau\alpha$, he split, as lately mentioned, into three families, under the names respectively of Vital, Natural and Animal Spirits, to each of which he gave, as well as a “name,” a “local habitation”—the first being placed in the heart, the second in the liver, and

Prometheus.

Hippocrates.

Galen.

Four
elements.

If organism, it is confidently asked by most of the supporters of the Vital Principle doctrine be, either the last in the brain; and thus conferred a most essential favour on the subsequent physiologists of the Vital Principle school, by supplying them with a most convenient *Θεὸν ἀπὸ μηχανῆς*, to be always conjured up when any difficulty was to be explained, or at least disposed of. In this way then Life came to be regarded as a substantial Existence, like that coarser kind of Fire which was one of the four reputed elements of all things; and as the latter, when it entered into bodies, was represented as the cause, as well of their general physical properties, as of the peculiar phenomena which they displayed during combustion, so the former, on becoming a denizen thereof, was described as the cause, first of their organization, and afterwards of the peculiar actions by which, when so organized, they were distinguished. And this view of the matter was perhaps the most natural to Man in the infancy of Philosophy, impressed as he was, from the first, with the idea that all matter—at least all the grosser forms of it—were essentially inert, and of course disposed therefore as he was, to ascribe all spontaneous motion to a union with the thing moved of some substantial moving cause. It was not easy even for the most exalted geniuses, with so limited a knowledge as they then possessed of the essentially different properties resulting from differences in the composition, substance and aggregation of different forms of matter, to do otherwise than attribute the distinctive actions of organized beings to some hidden Principle operating within them, of which inorganized matters were destitute; but it might have been expected that such vague surmises as this would long before this time have sunk under a more enlightend Philosophy, and that Life as a substance would long since have shared the same fate as Fire as an element. Such however has not been the case, the

directly or indirectly, the cause, or one of the causes, of Life, what is the cause of organization, or that process

notion that Life and living action are quite distinct, the former being the substantial cause of the latter, having descended from the authors above enumerated, through Van Helmont, Harvey, Borelli, Perrault, Stahl, Carl, Coschwitz, Swammerdam, Whytt, Sauvages, Bordeu and Barthez, to Plenck, Platner, Hufeland, Sprengel, Schmidt, and other writers of the close of the last century. From these it has been transmitted unadulterated by Abernethy, Lamarck, Pring, Barclay, Good, Davies, Bell, Prout, Kirby and others, down to our own times; and we are still condemned to hear the terms Vital Spark, Vital Spirit, Vital Principle and so forth continually used, not only by the vulgar, but by philosophers of eminence, as referring to something which has confessedly a real and substantial existence, and the human body is still sometimes described as consisting of solids, fluids and a Vital Principle, almost in the same words as were employed between two and three thousand years ago by Hippocrates. Of course the said Principle has acquired in its progress some new names, as in the hands of Van Helmont, who, as he could not of course use any term which had been employed by Galen, called it Archæus, a term borrowed from Paracelsus; and, instead of being shorn of any of its blushing honours, has even been invested with higher attributes than of yore, as in the hands of Stahl, who very much extended the powers of the ancient $\Psi\upsilon\chi\eta$ or Anima, to which term he had, after Harvey, returned. The term Vital Principle originated with Barthez, and was invented to signify something distinct from either mind or body, but nevertheless in all probability subsisting by itself, although he confessed that he could not determine "whether it were a substance, or only a mode of the living body." Whytt has been called a semi-animist—a half-stahlian. Barthez

Writers on
Vital
Principle.

Barthez.

from which organism itself resulted? Can any known chemical or mechanical forces give rise to so specific a

may perhaps with equal propriety be called a semi-substantialist—a kind of stepping-stone between the Entity and Non-entity schools. John Hunter was perhaps the first to identify the Vital Principle with Electricity or Galvanism. It has been denied by some that John Hunter was really one of the Subtle fluid persuasion, (*Ann. of Med. and Surg.* 1817—*Lawrence's Lect. on the Physiology of Man*, 1819) and it is quite certain that his “*Materia Vitæ*,” which was the solid nervous substance, was nothing of this ethereal nature. But this was with him only the material domicile of Life, not Life itself, which, in as far as he identified or associated with Galvanism, he certainly made a fluid of the nature above described. With respect to the modifications of the doctrine which maintains the existence of Life as a substance by those who have most recently written on the subject—and it seems quite superfluous to go further back than

Abernethy. the present century—Mr. Abernethy, who treads everywhere so closely in the footsteps of John Hunter, believes of course that Life is, if not identical with, certainly analogous to, Electricity or Galvanism (*On Mr. Hunter's Theory of Life*, 1814); but the refutation of this unfortunate hypothesis may be advantageously deferred till the subject of Electricity or Galvanism, as a stimulus to irritability, falls to be considered: in the mean time it is sufficient to say of it, that anything more vague and visionary has never hitherto obstructed the progress of physiological science. Of the same stamp is the hypothesis of Lamarck, that Life is a compound of Electricity and Light. By Dr. Pring on the contrary the Vital Principle is represented as a substance quite *sui generis*, and he speaks of a “sum and quantum of Life,” with as much confidence as if it could be meted out by the help of a pair of scales, or a glass measure; while it is an inference from his hypothesis, that, as Life is on the

composition, so complicated a substance, so heterogeneous an aggregation, and so determinate a body, as those

one hand a cause of organization, so organism is on the other a cause of Life, since the substance of Life is continually renewed, he assures us, "by the assimilation of its identity from the blood" (*On the Laws of Organic Life*, 1819). But if the substance of Life be renewed from the blood, it must either have entered the blood in propria persona with the food, in which case the said food ought to be alive, or it must have been formed by the blood, in the manner of a secretion: and from what ingredient of the blood secretion can produce *de novo* a simple substance, material or immaterial, remains to be explained. But perhaps the substance of Life is not simple—and indeed we are told that "the influence of Life is to separate from the blood those elements which constitute its own identity;" and elsewhere, that "animal heat is a part of the principle of Life." *Elements and parts of a Principle—material ingredients* of that which even those who look upon it as substantial still generally consider as *immaterial*! But it is mere waste of time discussing such "verba et voces prætereaque nihil" as these. Dr. Barclay's work (*On Life and Organization*, 1822), extolled, as it has of course been, by those who advocate similar opinions, consists not so much of a statement of arguments in favour of the existence of Life as a substance, as of a parade of authorities on the question whether Life be the result of organism, or organization be the result of Life—a question only indirectly connected with the one at issue, since, although most of those who contend for the existence of Life as an entity adopt the latter opinion, there are some of them, as elsewhere observed, who still imagine, like all those who deny this existence, that organization is independent thereof, and believe that Life does not enter the being till its organization has been effected. Dr. Barclay is not one of these; but presuming on the existence from

Barclay.

which characterise an organized being? It has been conceived indeed even by some of the supporters, on other

the first of a substantial Principle, which may be called indiscriminately Vital, Sensitive, Rational or Immortal—a most unfortunate but not very unusual jumble—he indulges in a tirade of somewhat captious abuse of the head and heart of everybody—in particular of Blumenbach, Cuvier, Cabanis and Lawrence—who presume to differ from him, and whose tenets he vaguely conceives likely to interfere with “the raptures of Moses and the Lamb” (p. 399). Dr. Barclay was an excellent anatomist and an excellent man; but as good anatomists and as good men as he have entertained, and still entertain very different sentiments on these matters. In the

Mason Good. same track follows Dr. Mason Good—a name hardly less notorious in physiology, than eminent in literature—who, in ridicule of the doctrine that Life has no real existence, which had become by this time rather inconveniently prevalent, facetiously remarks, “the human frame is hence a barrel organ, possessing a systematic arrangement of parts, played upon by peculiar powers, and executing particular pieces or purposes, and Life is the music produced by the general assemblage or result of the harmonious action” (*Study of Medicine*, 1825, vol. iv. p. 44). He could not possibly have illustrated the nature of Life, consisting as it does in the proper actions of *organ*-ized beings, more happily—“We thank

Pring. thee, Jew, for teaching us that word.” Dr. Pring instructs us only how the substance of Life is continually renewed; but Mr. Davies in some otherwise excellent papers in a medical journal teaches us how it is subsequently disposed of, assuring us that “it combines with the structure by means of affinity, as well as forms that structure by the same power,” (*London Medical Repository*, 1827), a circumstance which it must be extremely gratifying to every body to be aware of, particularly as it is so satisfactorily demonstrated.

grounds, of the doctrine in question, that such may be

Dr. Alison in his recent work avoids, perhaps judiciously, entering into any discussion respecting the nature of Life; a word which "does not," he inadvertently observes, "denote a simple idea, and therefore cannot be defined" (*Outlines of Physiology*, 1831, p. 1), a diametrically opposite reason being offered with more propriety a little further on (p. 151) for not attempting a definition of sensation or thought. He is obviously inclined however to regard Life, not indeed as anything material, but still as an entity, since he describes organization as one of its effects; and accordingly we find his reviewer stating, in opposition to the more modern opinions concerning the nature of Life, that "it is a sad confusion of all etiological relations, which ascribes to the passive and naked effect the very existence of the agent to which this effect owes its being" (*Medico-Chir. Rev.*, 1831). Still more recently also Mr. Thomas, in allusion to the same doctrines, has observed, "We have first the effect, and secondly the sum total of the effect entering into an unnatural conspiracy to produce, by an ex-post-facto operation, a cause for an antecedent operation" (*Liverpool Med. Gazette*, 1833). Now this is precisely what we *have* in the entity view, and what we *have not* in the non-entity view of the matter in question; for in the former we have first Life ($\Psi\upsilon\chi\eta$) represented as forming the structure, and then the structure represented as forming Life ($\Psi\upsilon\chi\eta$), whereas in the latter, Life is admitted as an effect alone—as a $Z\omega\eta$; and it is only therefore upon the unjustifiable *petitio principii* that life exits as a $\Psi\upsilon\chi\eta$ —the q. e. d.—the very point at issue that these objections are founded. There needs no ghost come from the dead to tell us that an effect cannot be the cause by which that effect was produced; but had the opponents of the latter view of the matter understood the doctrine which they impugn, they would have known that Life is regarded by the advocates of this doctrine,

Alison.

the case, and that the substantial Life may not perhaps enter such a being till it has become organized by

not as a cause of vital action, but as identical with it, the cause being the co-operation of a certain property and certain powers, both quite distinct from Life in either sense of the word. Sir

Charles Bell. Charles Bell, Dr. Prout and Mr. Kirby (*Bridgewater Treatises*, 1834) are among the latest authors who have contended for the existence of a substantial Life, but they have adduced none but the usual arguments in its favour; and the last is more than usually mystical upon the subject. Upon the whole, that there is any evidence whatever of the existence of Life as an Entity, those who maintain the opposite opinion are satisfied with denying, the onus probandi resting of course with those who support the proposition. It might otherwise be shown that the admission of this hypothesis brings with it many more difficulties than it removes; and that innumerable phenomena, which are easily explained without it, become quite inexplicable if it be admitted: but it is idle making giants merely for the purpose of killing them. It may appear, and indeed

Clark. it has been lately remarked by Dr. Clark (*Report on Animal Physiology, read to the British Association at Edinburgh*, 1834), that the views of most of the authors above cited from Aristotle downwards are in fact nearly the same as those at present generally entertained, and that if we substitute the word Property for Principle, and the word Vitality for Life, there is no essential difference between the two. It must be remembered however that in the more modern view of the matter this property is never regarded as *substantial*, nor ever as *per se sufficient* for the display of vital phenomena—points, which appear quite sufficient to constitute a fundamental difference between the two. The acrimony with which the contest has been sometimes maintained might be supposed to furnish of itself sufficient proof that the opinions entertained were not at all

other means ;* but it may be safely conceded to the most unqualified substantialist that no chemical or mechanical powers are competent to produce such an effect. It has been already shown at some length that the chemical composition of organized tissues is quite distinct from that of inorganized compounds ; and consequently the first step towards organism must require powers different from those by which inorganized matters are formed. It requires Life, but not a Living Principle. It requires the Life, or living action ($\Sigma\omega\eta$) of the thing *organizing* ; not any Living Principle ($\Psi\upsilon\chi\eta$) in the thing to be *organized*. It has been expressly stated lately that organized beings can be formed only by such as are already organized, the existence of any one implying always the reconcileable, did we not know that the most acrimonious disputes have frequently been those in which the question was *de verbo*, and not *de re*—but this is not the case in the present instance.

* This appears to have been the opinion of not a few of the authors lately enumerated as advocates of the Vital principle doctrine, and the list might have been swelled with the names of Descartes, Needham, Darwin, Priestley, Fray and many more ; who while they in general ascribe the proper actions of an organized being, when formed, to the presence of such a Principle, still consider its formation to depend upon certain chemical affinities, formative appetencies and so forth, quite independently of its operation. The general question however at present is—not whether Life, considered as a substance, perform *all* that has been attributed to it—but whether it be a substance at all.

Embryo, or-
ganization of.

pre-existence of some other ; and that the forming and separating from themselves, each in its generation, such new beings is one of the characteristic actions—that is to say a part of the Life—of plants and animals in general. The organization then of the embryo, or the process by which a new being is formed, possessed of organs however rude, and in virtue of its organism indued with irritability or vitality, is the work of the parent. Nor does there appear to be any greater difficulty, as at the same time observed, in conceiving this particular application of the process of secretion, than in understanding that by which every organized being, not only continually renews, in proportion as they are removed by absorption or other means, its own natural organized tissues, and sometimes whole organs, but also frequently deposits new ones, each of which is equally indued with irritability or vitality, as those germs which are the rudiments of beings of a future generation. Nay the difficulty is, in fact, less in the case of such germs, than in that of what are called new growths in general ; since in the former case we have to comprehend only the organization, or the formation by secretion of the rudimental structure in question, whereas in the latter we have to comprehend further the mode by which, at first distinct, as already stated, from the parent animal, it subsequently becomes a part of it. The germ then so formed by a vital action of

the parent, and possessed in virtue of its primordial organism of the property of irritability or vitality, maintains from the first, by the co-operation of this property and the natural stimuli by which it is excited, a series of actions constituting its Life; and it is by one modification of these actions necessarily resulting from its peculiar properties when acted on by appropriate powers and not by any substantial Vital Principle, that its full elaboration is effected. It is by this that in animals are formed, by means of the parenchyma laid down from a very early period in the apparently homogeneous germinal membrane, first the three principal layers of the latter, and subsequently all the tissues and organs of the body in a certain definite series; so that, though the organization of the embryo was the work of its parent, its organogenesis is its own, and parts which it received from the former in a state of diffusion and ambiguity, itself renders concentrated and determinate. But if the embryo be thus organized by its parent, how, it may be asked, was the first parent organized? If the first egg were the product of a bird, how was the first bird produced? With this problem the physiologist, in the strict sense of the word, has nothing whatever to do. The Almighty Creator—the first and the last—willed that, not only the inorganic, but the organic kingdom of nature should exist; but how either the one or the other

Creation.

was originally called into being He alone knows who said "Let there be light—and THERE WAS LIGHT"—

"Whose word leaps forth at once to its effect—

Who calls for things that are not—and THEY COME."

Any attempt, by a finite being, to comprehend the process of creation, even in the least of its manifestations, seems to be vain and presumptuous in the extreme. But it may be observed that the solution of the problem, how the first organized being of every species was formed, founded on the presumption that certain aggregations of matter, however effected, became indued in virtue of this aggregation with a distinct property, giving rise under fit circumstances to the phenomena of Life, is at least as simple and satisfactory as that which assumes that it was by Life, as a distinct substance, entering into matter, that these aggregations of it were effected; and that the latter implies a greater infringement of the law οὐδεν ἐξ οὐδενος than the former, is sufficiently obvious.

But a monad, it is alleged, that is to say, a globule of organic matter or presumed organic molecule, which cannot have even so rude a distinction of parts as is essential to any degree of organism, may still display some of the phenomena characteristic of living beings; and in fact such, it is said, are displayed in the union of these globules—as in the process of constituting the mould and animalcules in infusions of organic matters

—to form those very parts, the pre-existence of which is, on the other hand, considered necessary to give rise to irritability or vitality. This objection however to the doctrine which deduces vitality from organism has been incidently replied to already, by the refusal to admit that these globules are organic molecules, or that it is from a union of them that the mould and animalcules which are developed during the decomposition of organic matters result. Their origin is in all probability, like that of all other plants and animals, from perfectly organized germs;* nor does their extreme minuteness—and it has been computed that not fewer than five hundred millions of such beings may be contained in a single drop of water—furnish any fair objection to this presumption: nay, for any thing that we know to the contrary, myriads of similar germs may harbour in one such globule of extractive or sodo-albumen as certain authors have been pleased to look upon as a monad. What must have been the size of the germ which is to become an individual of the last generation of Man which is to inherit the earth, if, as supposed by some physiologists of the highest eminence,† it existed ready-made in the ovary of the first mother. But, reconcileable as all this is with the first principles of physical science, by which we are taught to regard matter as infinitely divisible,

* Ehrenberg.

† Haller, Bonnet, Spallanzani, &c.

Omne vivum
ex ovo.

imagination turns dizzy at speculations like these. The common-sense view of the matter appears to be that every organized being is secreted in a rudimental state by a pre-existing organized being, that it possesses from the first, not indeed the rudiments of each individual organ as it is in future to appear—a doctrine which is quite incompatible with the frequent metamorphoses which most of these organs are now known to undergo during their progressive development—but a rudely organized structure, in virtue of which it is indued with a certain property which enables it, when acted on by appropriate powers, to form in the apparently simple germinal membrane all its distinct tissues and organs;* and that these afterwards, in virtue of the same property acted upon by the same powers, display all the other phenomena of Life, including that of in their turn secreting other organized germs, which, when again acted on in a similar way, again go through a similar process.

It is, however, chiefly the singular and apparently anomalous nature of the characteristic actions of organized beings when fully formed, which, as it first

* “The Vital power (property),” says Dr. Clark, “is connected with the matter of the germ in the act of its formation,” and elsewhere “The disc is capable of being affected by the matter in its neighbourhood. It is *excited* and it *reacts*” (*Report on Animal Physiology*, 1834).

introduced, so it still serves to perpetuate the vague notion of some distinct substantial Principle as their cause. A corpse which has just ceased to live, that is to say to display any of those peculiar actions in which Life consists—respiration, circulation, deposition, absorption and so forth—cannot, without an effort, be conceived to have undergone so great a change, without having lost something substantial which it previously possessed, and which was the cause of its living. But if we reflect on these actions, anomalous as they appear, what do we find them in fact amount to but certain movements of either particles or masses of matter, not certainly identical with, but still very analogous to those which, in inorganized matters, we call chemical and mechanical; and which we are contented to ascribe, not to any substantial Principle of action, but to certain properties and powers resident in these matters, the reciprocal action of which gives rise to what are called attraction and repulsion? And why need we hesitate to admit that similar, though not the same properties and powers may, in organized beings, be competent, while they are in mutual co-operation, to effect those actions in which Life consists, and which of course terminate on the cessation of this co-operation, as the ingredients of a chemical compound cease to be agitated when their affinities are satisfied, and a watch stops when either the susceptibility of motion in

Analogy of
Life and of
Chemical and
Mechanical
Action.

its wheels is destroyed, or the requisite power ceases to operate upon them? It is true a living being *appears* to require no such repeated additions of new ingredients as a chemical compound, and no such frequent winding up as a watch, to avoid falling into the soon-established repose of the particles or masses of inorganic matter. But we must keep in mind that, in the latter case, while the properties and powers of the substances in co-operation are soon satisfied and exhausted, there is no inherent renewal of these substances, and with them of these properties and powers, to renew their proper actions; whereas, in the former, it is the specific end of some of these actions to give rise continually to new aggregations of matter, distinguished by the same properties, and acted on by the same powers as the old which have disappeared, so that the conditions of continual action are never for an instant suspended. It is not then that there is in living beings no addition of new ingredients, and no winding-up, but that this addition and this winding-up are incessant; and all that death implies therefore is a cessation of these as the necessary conditions of Life or living action, not any abstraction of Life, in its character of a substantial Vital Principle on which such action depended.

Evidence of
design.

But is not, it may be asked, design, such as can be attributed only to some such Vital Principle within

them, manifested in the heaving and falling of the chest, the contractions of the heart, and the other sensible motions of various parts, as subservient to the several functions of organized beings; and still more in the various molecular actions, whereby with undeviating accuracy every particle of the machine is removed and deposited precisely at the time, and in the quantity that is required, not only originally to form these several parts—the eye or ear, for example, those finished examples of exquisitely adapted workmanship—but subsequently to maintain each in a state of integrity, ever varying yet ever the same? Undoubtedly; design deep and wonderful, if not indeed in the specific adaptation, *in all cases*, of individual organs to particular functions—for we know that many such functions may be performed in different animals by very different organs—at least in such an association of the collective organs in each individual, that every necessary function is properly provided for. But this design is that of the Great First Cause of all things, who has adapted in every case the physical causes—the immediate means—to the end to be fulfilled; not that of this miserable means, which acts, and can act only in blind obedience to the laws imposed upon it.* Nor per-

* “To ascribe,” says Dr. Prichard, “to the Vital Principle such properties is to invest it, not only with reason and intelligence, but with the wisdom and power of an omniscient Creator, who, if He

haps are the evidences of design really greater in the motions, sensible or insensible, of the organic, than of the inorganic kingdom of nature, nor is the employment of the terms means and end—not merely cause and effect—more appropriate in the former case than in the latter.* The final causes are often no less obvious in the actions of inorganized than of organized matter. Can we behold the revolutions of the planets—the alternations of the seasons, and of day and night—

Hunc solem et stellas, et decedentia certis
Tempora momentis—

at one time the ascent of the waters into the atmosphere, at another its descent in rain or snow—the motions of the sea, the rivers and the springs—the occasional changes on the surface of the earth itself—without recognizing an allwise and omnipotent design?

works by second causes, cannot be conceived to endow them with his proper attributes. Such language is an abuse of words, and contrary to every maxim of philosophy" (*On the Vital Principle*, 1829, p. 123).

* "Cause and effect," says Dr. Roget, "are concerned only with the natural powers of Matter—means and end involve the operations of Mind in conjunction with those of Matter," (*Bridge-water Tréatise*, 1834, p. 22). But such cause and effect frequently imply no less than the operations of an Almighty Mind; and it is impossible that means and end can imply more.

Nor are the molecular actions here also—the aggregation of a crystal or a stalactite for example, or the feathery condensation of a vapour—less indicative of an end in view in their operation, or of consummate skill in regulating and adapting the means to this end. In the latter class of cases, however, we unhesitatingly admit that the design is, not that of the means—of the mere so-called forces of attraction and repulsion—but that of the Great Author of these forces; and why should we doubt that the same is the case in the former also? Nor are even the means employed perhaps less intricate and complicated in the instance of inorganic than of organized matter. When we speak of attraction and repulsion indeed we seem to be speaking of simple forces, producing certain actions; but we are in fact speaking of the actions themselves—those of attracting and of repelling—the forces being in both cases quite distinct from these actions, and consisting of a property of being attracted or repelled on the one hand, and a power of attracting or repelling on the other. And what more do we contend for with respect to Life than that it is, not a substantial Principle operating as a simple force, but a series of actions, resulting from the property of irritability or vitality operated upon by appropriate powers?*

Forces of
Nature.

* Magendie says it is “une étrange erreur” to compare vital action to attraction, because, while the laws of attraction are well

Magendie.

then in reality more singular in the actions of organized beings than in those of inorganized matters—nothing more indicative of design—nothing more obscure—nothing which stands more in need of a substantial Principle, or resident Entity, to account for it. We may indeed, if we please, in conformity with the views of many philosophers, not only ancient but modern, call these actions of Inorganized matters,

known, those of vital action lie totally concealed. But the latter part of the proposition is not quite true ; nor would it furnish a fair objection to the comparison even if it were. The conditions of attraction do not more certainly exist at present than they did before Newton discovered the laws which these conditions obey, nor do those of vital action less certainly exist at present than they will do when the laws which they obey shall have been fully ascertained. The assumed analogy is between the general conditions of the two, as constituting respectively the proper actions of different forms of matter ; not between the specific laws which they severally obey. With how much greater truth is it observed by

Wilson Philip. Dr. Wilson Philip, “ The phenomena of Life are as open to observation and experiment as the phenomena of any of these powers, (i. e. those of attraction &c.) and we possess no information respecting any of them, but such as is derived from the senses. The greater appearance of mystery arises, not from the greater obscurity of the nature of Life, but from its phenomena bearing less analogy to those of the other powers of nature, than these bear to each other, in consequence of which the former are less frequent objects of contemplation” (*Phil. Trans. republished in Essay on Sleep and Death*, 1835).

chemical and mechanical, their Life ; but then, to be consistent, we must either allow, as the ancients did, a Vital Principle to inorganized matters in common with organized beings; or we must refuse to the latter a Principle of which the former are almost universally regarded in the present day as destitute. It is not contended that we understand the nature of any of these actions—it is not contended that we advance one step towards explaining them by ascribing them to the agents in question. But it is contended that we understand the nature of vital, as well as of either chemical or mechanical action : and that if we are satisfied to attribute the two latter to the agents above specified, as is almost universally done, we cannot without great inconsistency refuse to ascribe the former, which are in every respect so analogous to them, to similar agents, instead of to an imaginary substantial Principle, of the operation of which there is no more proof nor probability in the one case than in the other. Of the immediate nature of physical causes in general we know absolutely nothing, since we are capable of recognizing their existence only by their effects. We know not how or why a certain aggregation of matter called phosphorus should be capable, when exposed to certain agents under favourable circumstances, of exhibiting the phenomena of combustion ; or a certain other aggregation of matter called ivory should be

Physical
Causes.

capable, when struck by a hard substance, of displaying those of sensible motion. But we know that they do so ; and we satisfy ourselves in these instances with stating that the phosphorus is, *qua* phosphorus, combustile, and the ivory, *qua* ivory, elastic, without ascribing to them any substantial Principle of combustion or sensible motion. In like manner we know not how or why a certain aggregation of matter called organized should be capable, when acted on by certain appropriate powers, of manifesting the phenomena of Life. But we know that it does so—that the more perfect is the organism, the more remarkable are these phenomena, and that any change in the former produces a corresponding change in the latter ; and what other proof can we require or possess that organized matter is, *qua* organized, irritable or endowed with vitality, and that it is not upon any substantial Principle of Life that these phenomena depend ?

Vitality.

But admitting, it may be said, that quite the lower tribes of Organized beings do not display any actions which may not be explained away without conceding to them a substantial Vital Principle, it is impossible so to dispose of some of the more exalted actions of the higher—actions which are surely in no respect analogous to such as are merely chemical or mechanical ? If however this sovereign principle can be dispensed with even in those chaotic tribes from which each king-

dom of organized nature takes its rise—and to which, since they are often with difficulty distinguished either by their structure or their actions from mineral substances, it can hardly be considered necessary, even by the most determined substantialist—it will be difficult, if not impossible, to say at what point afterwards, in either of the ascending scales, it can be abruptly introduced. For so insidious are the steps by which we ascend from these to the very highest tribes of organized beings, and so slightly superior the actions of each tribe, as we proceed, to those of the one immediately below it, that we are compelled to grant that what was unnecessary to the one can hardly be necessary to the other; and that consequently what we denied to the Fungus and Polype must be denied equally to Man. And with respect to the more exalted actions of the higher tribes of organized beings, such as sensation and thought, these have manifestly no immediate connection with the existence of a Vital Principle; since, while on the other hand they are certainly not a necessary consequence of its presumed presence, so on the other they may be easily supposed capable, where they are manifested, of doing without it. Many races of organized beings exhibit no traces whatever of these actions, and are still alive; and even in those tribes which habitually exercise them, they are always periodically to a greater or less degree suspended, as dur-

ing sleep, and sometimes totally cease for an almost unlimited time, as in comatose diseases, without prejudice to the Life of the being. Whatever substantial Principle or Principles then we may find it convenient to introduce in order to explain these more exalted actions, it is obvious that they cannot be identical with the one called Life, and that it is not they which

“——agitant molem, et magno se corpore miscent.”

The admission then of one, or even of two such additional Principles, under the names of Sensitive and Rational, would not in any degree imply the existence of that called Vital, as the main agent of those baser actions in which alone Life, properly called, consists. On the other hand many of the arguments tending to disprove the existence of a Vital Principle serve to render it probable, *a priori*, that that of either of the others is also imaginary; and that, as one specific property, namely irritability or vitality, which is common to organized matter in general, qualifies it when subjected to appropriate stimuli to manifest those ruder and less elevated actions which constitute Life, so other specific properties, peculiar perhaps to certain forms only of such matter, may qualify them when properly acted upon to display those more delicate and dignified actions in which sensation and thought respectively consist. But into this department of the

Rational Principle.

discussion it is unnecessary and inexpedient to enter at present.

The third head of evidence commonly adduced in favour of the existence of a substantial Vital Principle is founded on the presumed incompatibility of the opposite doctrine with a belief in the immortality of the Soul. There is in the minds of many persons, not only among the uninformed, but also among the educated, a vague, indefinite kind of impression, that the Vital Principle, the Sensitive Principle, the Rational Principle and the Immortal Principle, are all identical; and that he who denies the substantiality of the first does the same with respect to all the rest. This impression appears to have originated in the ancient complicated absurdity of applying to the three supposed principles of Life, of Sensation and of Thought, and to the one real-Principle of Immortality, the same name, as Soul, Spirit and so forth*; an absurdity which, regulating as

Soul.

* An attempt was indeed made at a semi-distinction by Aristotle, who, while he confounded together the Vital, Sensitive and Immortal Principles, under the general name of *Ψυχὴ* or *Εντελέχεια*, still subdivided this into the *Θρεπτικὴ*, or simply Vital, and the *Αισθητικὴ*, or Sensitive and Immortal, and at the same time admitted a distinct Rational Principle under the name of *Νοῦς* or *Φρὴν*; and a similar distinction was affected by the Romans, who, while they called the Vital and Sensitive Principles collectively *Anima*, distinguished the Rational by the name of *Animus* or *Mens*. Thus Juvenal—

Aristotle.

Juvenal.

it has done, as well our most philosophical, as our most familiar expressions on these subjects, has not only always influenced to an incredible extent the ideas

“Indulsit communis Conditor illis

Tantum Animas, nobis Animum quoque,” &c.

Galen. Galen again tried an arrangement somewhat different, splitting, as before remarked, the Vital Πνευματα into two classes, under the names of proper Vital and Natural, while he packed on the contrary the Sensitive and Rational together, under the name of Animal. None of these proposed distinctions however were ever steadily maintained; and indeed it was impossible that they should be so, thus discordant and irreconcilable as they were. Dr. Barclay

Barclay. indeed coolly argues that they were all unfounded; and that the four substances in question, real and supposed, are in fact all the same. The Immortal Principle he everywhere identifies with the Rational, as being responsible for the backslidings of the latter; and the Rational again must be identical, he infers, on the one hand with the Sensitive, and on the other with the Vital, for “What,” says he, “can it will or think without feeling, and how can sensation subsist without life?” (*On Life and Organization*, 1822, p. 495) Upon such principles as these we might undertake to prove, on the one hand, that a surety is identical with the man for whom he is bound, and, on the other, that the second story of a tenement is identical with the first, and the third with the second, because they cannot respectively subsist independently of each other. Mr. Abernethy had some time before contended against confounding perception and intelligence with mere vitality; (*On* Prichard. *Mr. Hunter's Theory of Life*, 1814) and Dr. Prichard rationally concludes that at least the Vital principle and the Sentient, Cogitative and Immortal principle—all which he unfortunate-

of the vulgar, high as well as low, upon these matters, but introduced into the best parts of the writings of even the greatest philosophers upon the subject of Life, so much error and confusion, that we are frequently compelled, while perusing them, to dissent from one half of those propositions in the remainder of which we most cordially coincide, and close their works in general chagrined and disappointed that what, but for this fatal amalgamation, might have been rendered so clear and perspicuous, should have been presented to us only "through a glass darkly." Upon this subject in general however it is sufficient to observe at present that no arguments adduced against the presumption of the existence of a Vital Principle—although, in as far as any arguments can establish a negative proposition, apparently conclusive—bear at all, otherwise than analogically, against that of the existence of either a Sensative or a Rational Principle; nor do any arguments adduced against the doctrine which teaches that these exist—strong though they be—tend to shake in the slightest

ly regards as one and the same—"supposing for a moment that both really exist, are entirely distinct in their nature and attributes" (*On the Vital Principle*, 1829.) To a similar effect says Dr. Alison, "Whatever notion we may entertain respecting the existence of a Vital Principle, it has no connection with our notion respecting the existence of Mind &c" (*Outlines of Physiology*, 1831, p. 3).

Alison.

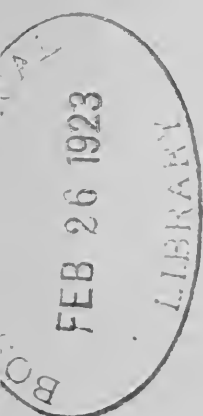
degree, either analogically or otherwise, our faith in—our conviction of that of the Principle of Immortality. That the Soul is something entirely independent of either a Sensative or a Rational Principle; will be as far as possible demonstrated in future; and that it is independent also of a Vital Principle must in the mean time be obvious to any one who considers for a moment that this latter Principle is ascribed indiscriminately to every organized being—a quadruped, a bird, a reptile, a fish, an insect, a worm, a zoophyte, the lowest fungus—while a Soul is imputed to Man alone. The differences in the vital phenomena displayed by the most abject tribes of organized beings and by Man are only in degree; in this respect *Faba est cognata Pythagoræ*; the Principle which we concede to the latter as the cause of these phenomena must be conceded equally to the former; and if in the one case this Principle

“Redit in nihilum quod fuit ante nihil”—

if it be in the one case “the be-all and the end-all,” it must be so in the other also: so that to connect Man’s hopes of immortality with the admission of a Vital Principle within him, is so far from favourable, that it is directly opposed to all the best persuasions of religion, natural as well as revealed. But the hopes and expectations of Man are founded, or should be founded, on a basis infinitely more sure than the supposed existence within him of any such Principle—on a basis

proper to him, not common to him and the vilest worm or weed—on the suggestions of his reason, and on the strength of his faith; and as, so long as these actuate him, every other evidence of the existence of a Soul must be superfluous, so, were these once withdrawn, every other evidence must be nugatory.

So much then for the alleged testimony in favour of the *Existence* of a substantial Vital Principle. The next subject of inquiry, had this been established, would have been how far it might be regarded as adequate to effect all that has been ascribed to it: but into this question, after the express and unqualified denial of its existence above conveyed, it seems quite unnecessary to enter. A successful hypothesis has been compared to a key which fits and opens a lock; but when no part of the structure or motions of a lock are such as to warrant a presumption that there ever was a key, such as has been supposed, made to open it, or that it wants any such key, it seems idle to inquire whether such a key might not be competent, if found, to answer the purpose: we should rather proceed at once to open the lock by such means as its construction and mechanism seem to require, and such as we have immediately at our command. It may be shortly observed however, with reference to this question, that it is utterly impossible to conceive any single Principle or agent capable of effecting *per se* all, or a thousandth



part of what has been imputed to this mysterious offspring at once of imbecility and boldness, of helplessness and daring. To resist chemical agency—to keep in constant motion the respiratory muscles and heart of animals, as well as to excite all the other muscles of the body, as occasion may require—to generate heat and cold—to effect every where the continual deposition and absorption of all kinds of different matters—to select or assimilate the aliment—to form and organize germs—to repair wounds and repel and conteract diseases—and to effect innumerable other processes, must require collectively, not only numerous modifications of any common property, such as we may presume to belong to organized beings, but numerous distinct powers to act on this property thus modified; and such actions must be attributed therefore, not to any one self-sufficient substance, however active and however intelligent, but to countless irrational and unconscious forces incessantly at work in every point of the system, in blind but implicit obedience to laws imposed upon them by the Supreme Being, and adapted every where to the end to be fulfilled.*

* It is excellently remarked by Dr. Prichard, "The hypothesis of a Vital Principle is a weapon ready to cut any knot, but capable of untying none" (*On the Vital Principle*, 1829, p. 128); and Dr. Thompson. Thomson observes that "to employ the term Life or Vital Principle to designate a single cause, power or property of the organ-

Since then the attempts to establish the existence of a Vital Principle as an Entity may be regarded as having failed—not to mention its incompetency to effect the phenomena which have been attributed to it, even though its existence had been established—we seem compelled to acquiesce in the proposed alternative, and to admit that Life is merely an abstract term, used to denote the sum of these phenomena, the forces immediately effecting which are to be sought for, at least partially, in the results of organism.* It seems

Life—definition of.

ized body, upon which the whole of the phenomena of living beings depend, seems as unphilosophical as it would be if, after inventing a term to denote all the various operations on which the motion of a complicated piece of machinery depends, we should fancy to ourselves that a general term so employed denoted a common power from which all these various operations proceeded" (*Life of Cullen*, 1832, vol. i., p. 450).

* Some faint glimmerings of the true nature of Life had, from time to time, broken in upon physiologists, even during the long period that the Vital Principle doctrines remained formally unquestioned; and it was as illumined by one of these that Mead compared the living body to a machine, endowed with the property of perpetual motion, "owing to its parts being so disposed that, while they performed their respective functions, they constantly and mutually repaired each other." That Life consisted in this motion however had never hitherto been explicitly taught; nor was it till long after the essential condition of this motion, namely irritability, had been discovered, and the laws which it obeys had been established with considerable precision, that it began to be inculcated

indeed easy to conceive that certain forms of matter may be possessed of properties distinct from such as are that it was in the phenomena resulting from the constant co-operation of this property and the stimuli which act upon it, that Life

John Brown. consisted. Perhaps it was at the hands of John Brown—low as was his condition, vagabond as were his habits, erroneous as were in many respects his views, pernicious as was his practice, and scorned and reviled as is for the most part his memory—that the “Vital spark of heavenly flame,” of which we have been speaking, received its first blow, and a degree of closeness and precision was introduced into physiological and pathological reasonings, of which, so long as men had the free use of this *Deus in fabula*, such reasonings would of course be destitute. It was he who distinctly showed for the first time, about the year 1780, that Life as a $\Psi\upsilon\chi\eta$, or Anima, did not exist, being neither matter itself, as the Stoics and Epicureans among the ancients, and Dr. Priestley among the moderns, had supposed, nor an immaterial substance added to matter, as almost all the rest of the ancients, and so many of the moderns, had imagined; but that, as a $Z\omega\eta$, or Vita, it consisted merely in a series of motions performed by organized beings, and resulting from the action of certain exciting powers attached to matter, on a certain susceptibility in other matter of being excited. “In all states of life,” says Brown, “Man and other animals differ from themselves in their dead state; or from any other inanimate matter, in this faculty alone, that they can be affected by external agents, as well as by certain functions peculiar to themselves, in such a manner that the phenomena peculiar to the living state can be produced” (*Elements of Medicine*, 1788, vol. i. ch. 2). The whole merit of Brown however consisted in his including the necessity of a second condition—that of the constant co-operation of stimuli—to the phenomena of Life; since he was, in one view of the matter,

either strictly chemical or strictly mechanical—at least, as these properties manifest themselves in organized a confirmed substantialist, denying indeed the existence of *Life* as an entity, but every where speaking of Excitability or *Vitality* in that character. It is unnecessary to say how eagerly this view of Brown's was taken up, and how extensive an influence it had upon the pathological doctrines of his day; nor was it long in making its way among physiologists also. Among the first to adopt it was the venerable Blumenbach of Gottingen, who, although he has always continued, like many others of the same way of thinking, to use the word Vital Principle, still constantly speaks of it, not as a substance but as a property—so that the term becomes synonymous in his hands, as the term Life unfortunately is in those of his translator, Dr. Elliotson, with Irritability or Vitality—and explicitly asserts that no such actions as constitute Life can take place except when this property is acted upon by the requisite stimuli (*Institut. Physiol.* 1786, sect. 4). Similar doctrines were promulgated soon afterwards by Soemmering and Reil, the latter of whom describes Vitality as the effect of the form and constitution of matter, and Life as this property in action (*Archiv. für die Physiologie*, 1796); and they began, about the same time, to be taught in France by Baron Cuvier and Bichât. According to Cuvier—a name still deservedly in the highest repute, not less in physiology than in anatomy, notwithstanding the vituperation of his logic by Dr. Barclay, and the charge of hebetude latterly preferred against him by Geoffrey St. Hilaire—Life consists in “l'ensemble des phénomènes qui ont donné lieu à sa formation;” and he well remarks, that to define it with precision is to run over in detail all the characteristic actions of living beings (*Leçons d'Anat. Comp.*, 1799). Bichât again describes it, in exactly the same acceptation, as “l'ensemble des fonctions” —unfortunately adding however “qui résistent à la

Blumenbach.

Soemmering.
Reil.

Cuvier.

Bichât.

matters—and that, as combustibility and elasticity, as before observed, are properties of certain forms of such Mort”—unfortunately, because these words, if they were intended to imply that death is anything substantial, are absurd, if only that it is the cessation of Life, superfluous (*Anat. Gén.* 1801, and Richerand. *Sur la Vie et la Mort*, 1802). According to Richerand “on appelle du nom de Vie une collection de phénomènes qui se succèdent, pendant un temps limité, dans les corps organisés; and he further remarks that all the misconceptions concerning the nature of Life “tiennent à ce que, ne voulant pas la considerer comme un simple résultat, les physiologistes l’ont perpetuellement confondue avec les propriétés vitales” (*El. de Physiol.*, 1804, p. 1). The same view of the matter was taken by Cabanis; according to whom, “Vivre n’est autre chose que recevoir des impressions, et exécuter les mouvements que ces impressions sollicitent” (*Rapports du Physique et du Moral de l’Homme*, 1805, tom. ii. p. 137); and although he also speaks of a Vivifying Principle or faculty, namely Irritability or Vitality, as “la condition sans laquelle les phénomènes propres aux différens corps organisés ne sauroient avoir lieu,” distinctly adds “Je suis surtout bien loin de vouloir conclure affirmativement de ces phénomènes l’existence d’un Être particulier, remplissant la fonction de Principe, et communiquant au corps les propriétés dont leur fonctions résultent” (Tom. i. p. 245). In the mean time the same tenets were taken up in Italy, among others, by Rolando (*Sur la cause d’où dépend la Vie*, 1807) who beautifully describes Life as “le complément des fonctions,” and consequently “un état forcé,” they were further maintained in Germany, among many others, by Prochaska and Hildebrandt; and shortly afterwards were adopted by Mr. Lawrence, who was the first to present them in their properly physiological aspect—for by Brown the application of these doctrines had been principally pathological and

matters, so a peculiar susceptibility of another description may be in like manner a property of organized therapeutical—to the physiologists of this country. Lawrence speaks of the substantial Vital Principle as hastening fast, at the time at which he wrote, to “the vault of all the Capulets;” and, following very closely Blumenbach, Cuvier and Bichât, represents Life as “consisting in the assemblage of all the functions or purposes of organized bodies, and the general result of their exercise” (*Int. to Comp. Anat.*, 1816, p. 120), a definition which gave rise to the facetious comparison, already spoken of, by Mason Good of the human frame to a barrel organ. These doctrines of Mr. Lawrence owing to some extraneous leaven with which they were unhappily and very unnecessarily mixed, but which needs not be particularly noticed in this place, were for some time any thing but popular in Great Britain; but they were nevertheless adopted, with some mitigations, by Burns, Gordon, Allen and others, and, not only unmitigated, but in rather an aggravated form, by Sir Charles Morgan. Like his predecessors in the same field, he defines Life to consist in “the sum total of functions which any individual can perform;” but, unlike them, he denies the existence in organized beings, not only of any substantial Principle of action, but even of Irritability or Vitality, as a property essentially distinct from those of which inorganized matters are possessed; “the difference between the two,” he says, “being purely formal” (*Philosophy of Life*, 1818, p. 29). To this *ultra* proposition however as applied to the actions, any more than as applied to the structure of the two, in which respect also, as we have already seen, some attempts have been made to indentify them, it is impossible to assent. Similar general doctrines were in the meantime advocated in France by Magendie, Broussais, Adelon, Dutrochet, Brâchet and others—in particular by Adelon, who, after enumerating the chief

Morgan.

Adelon.

tissues. And it seems equally easy to conceive that, as the combustibility of a combustible substance, or the

actions of organized beings, says expressly, "ces actions—constituent une Vie;" (*Physiologie de l' Homme*, 1823) and whose three admirable chapters on the Philosophy of Physiology might serve to settle, in all but the most blindly prejudiced minds, once and for ever the question respecting the existence of Life, "comme un Etre

Milligan. réel." (Tom. iv, p. 645) Dr. Milligan, the translator of Magendie, observes, in allusion to the doctrine of a Vital Principle, "the student will do well, in all such dubious expressions by authors, to substitute for Vital Principle the words Vital State or Vital Action." "The primary idea of Life," he remarks, "in our language, signifies motion—and if we analyze the idea, as it arises in our minds, we shall find that an inherent or independent power of motion, accompanied by frequent, actual, appreciable motion, constitutes the whole of our notion of Life, before it is adulterated by the study of the natural sciences, and the writings of philosophers." (*Translation of Magendie's Comp. of Physiol.*, 1823, note to p. 9, 1.

Mayo. 16) Mr. Mayo again says, almost in the words of Lawrence; "the term Life is a collective expression for an assemblage of phenomena." (*Outlines of Physiology*, 1827, p. 8, and 1833, p. 2) But the author who in modern times has most systematically and successfully taken up the cudgels against the substantialists is Dr.

Prichard. Prichard, who, after enumerating, in a masterly manner, the chief phenomena to explain which a substantial Vital Principle has been so unnecessarily put in requisition, and showing the polypragmatical and often inconsistent nature of the part assigned to it, concludes "that the hypothesis of a Vital Principle has been proved, by a careful examination, to be wanting in every characteristic of a legitimate theory." (*On the Vital Principle*, 1829, p. 132) Dr. Prichard is somewhat too fond of chemical and mechanical ex-

elasticity of one that is elastic, displays itself only when the former is subjected under favourable circumstances planations of vital processes, but, in as far as he admits of Vitality at all, seems to be persuaded that it results from organism; and it is only from having fallen into the common inaccuracy of confounding Vitality with Life, that he objects to the definition of Life given by Cuvier, Bichât and the rest, and says "that Life (meaning Vitality) may subsist without the performance of any function" (p. 1). They agree in fact, but differ in words. Since this time various other authors have adopted this view of the nature of Life—among the rest the laborious and talented Tiedemann, by whom the term Life is distinctly restricted to signify the sum of the actions, or, as he calls them, manifestations of activity of organized beings; and who, speaking elsewhere of Irritability or Vitality, aptly remarks, "how wrong the physicians and philosophers have been who created it as a fundamental force of Life, or the Principle of Life ($\Psi\upsilon\chi\eta$). They have mistaken for the cause of Life a simple property of organized bodies, which is the consequence of the plastic force" (i.e. of their organism) (*Translation of Tiedemann's Physiology, by Gully and Lane, 1834, § 82 and 557*). Lastly Dr. Roget, in his highly classical work published last year, describes Life as "consisting of a continued series of actions directed to particular purposes" (*Bridgewater Treatise, 1834, p. 58*); Dr. Wilson Philip, one of the most deservedly celebrated of British physiologists, albeit in some points perhaps mistaken, in a work published only a few months ago, aptly remarks, "Life, without much violence done to language, has been called a forced state—it consists of excitement called into action by suitable stimulants" (*Phil. Trans. republished in Essay on Sleep and Death, 1835*); and Dr. Clark, in his report still more recently published, describes living bodies as possessed of "as many species of excitability, and as

to the action of oxygen or some similar matter, when it gives rise to the phenomena of combustion, or the latter is struck by a hard body, when it gives rise to those of sensible motion, so this peculiar susceptibility of organized tissues manifests itself only when such are exposed to the agency of some peculiar powers, when it gives rise to the phenomena of Life. It is not Life then, but only a necessary condition of Life, namely irritability or vitality, which is the result of organism; and when we speak of organized matter we mean, not that it is endowed with Life—any more than any inorganic matter is endowed with combustion or sensible motion—but only that it possesses a property which, when acted on by appropriate powers, is competent to give rise to that series of actions in which Life consists.

Vitality as obvious as other quality.

Nor is the existence of this property of organized matter at all more doubtful, or its nature at all more obscure, as elsewhere remarked, than those of such as are chemical or mechanical. The latter indeed more frequently engage our attention, and what is familiar we easily persuade ourselves is real and intelligible; the many modes of reaction as there are tissues, and represents Life as consisting in this reaction, excited in each by its own appropriate stimuli" (*Report on An. Physiol. read in 1834—published in 1835*). The tendency in the human mind to personify its abstractions must really be insuperable, if it can resist all the weight of reason and authority which may be brought forward against the indulgence of it in this instance.

the former is seldom the subject of our contemplation, and what is rare generally appears, at first sight, fanciful and abstruse. But, upon reflection, we shall find that we have no more evidence of the existence, and know no more of the nature of combustibility, or of elasticity, than of irritability or vitality. It is from the effects alone of any one of these properties that we infer their existence, and determine their nature; and when we say of one substance that it possesses combustibility, all that we mean is that, when exposed to the action of certain other substances, it takes fire; of another, that it possesses elasticity, we mean only that when struck it rebounds; and of a third, that it possesses irritability, we mean only that when acted on by certain powers it manifests Life. We know fully as much therefore of any one of these properties as of the rest—that is to say, as we know matter only by its properties, so we know properties only by their effects. We know nothing of any one of these properties in the abstract, nor is it therefore by way of an explanation of any of the phenomena in question, that the terms denoting these properties are used.* They are employed

Properties
known only
by their
effects.

* Under whatever terms we may clothe the distinctive property of organized matter, it can signify only, as Magendie remarks, “la cause inconnue des phénomènes de la Vie.” It is not then to any thing that we understand better than these phenomena, but to something which we do not understand at all, that we refer when

merely as expressive of our belief in the existence of certain properties which, as recognized by their effects alone, we determine to be distinct only because these effects are in different cases altogether dissimilar.

ON IRRITABILITY OR VITALITY, REGARDED AS A PROPERTY OF THE ORGANIZED SOLIDS.

The notion of Life to be deduced from what has preceded is that it consists in the sum of the characteristic actions of organized beings, performed in virtue of a specific susceptibility, acted on by specific stimuli; and as this susceptibility and these stimuli, when natural, may be regarded respectively as the *Predisposing* and *Exciting Causes*, as it were, and the actions resulting from them as the *Proximate Cause* of HEALTH, so it is of some change in the first that every Predisposing cause, of some change in the second that every Exciting cause, and of some change in the last that every Proximate cause of DISEASE severally consist. But on this clear and simple doctrine of the connection between Physiology and Pathology—in this view of the nature of Life—it will be necessary to insist in future: at present we have to inquire a little more particularly into the character and sources of this susceptibility on the one hand,

we attribute them to irritability or vitality; and it cannot therefore be by way of *explanation* that we employ these terms.

and into the nature of those stimuli by which it is called into action on the other.*

It may be proper just to allude to Mayer's and Joule's Theories of Life and the equivalence of Force as explained in a pamphlet by Dr. Drysdale, one of the Editors of the Pathology of the late Dr. John Fletcher.

Mayer and
Joule.

Drysdale.

This doctrine of the equivalence of Force although it may be applicable to the phenomena of the inorganic world has no relation whatever to the properties, powers, or actions of living beings, and it is only by the use of the same word, sometimes as signifying matter at others certain conditions of matter, at others some of the properties of matter, or again as some mysterious agent influencing matter, that this theory is made, to apply at all to the actions of organized creatures.

Equivalence of
Force.

This last mysterious agent, conjured up whenever Mayer's theory is at fault under the name of Force, Power, Energy, or Vis Viva, has all the supernatural powers and ubiquitous attributes of the respectable old ghost—the Vital Principle.

In the appendix Mayer's hypothesis will be quoted to refute itself, but here it may be sufficient to mention what he calls his Laws.

* "Health and Disease are similar states differing only in degree." John Brown, vol. 1, p. 132 of Edit. 1788.

Mayer.

1. "That Forces are Causes, and that *causa equat effectum*—is most conclusive."

2. "Forces and Causes are indestructible but imponderable Objects."

3. "That which is essential to every Force is wanting in every *Property*—Forces are not properties but objects having the property of indestructibility and the power of taking on different forms—which is the second essential property of all *Causes*."

In Pathology, however, some of the best recognized Causes of Disease are not Objects, neither are they indestructible nor endued with properties of any kind, nor have they the power of taking on different forms, but are simply the qualities of certain objects, external to the organism in which they excite that change of action which we call Disease.

Such are Heat, Electricity, Disease or Irritation of one part when it becomes a cause of disease in another, Passions of the mind and Cold or more correctly the abstraction of the natural heat of the body—some examples of which will be found in the appendix.

APPENDIX.

NOTE 1.

SOME medical men pride themselves on their practical common sense, and yet employ language so figurative as to imply theories the most abstruse and incomprehensible.

NOTE 1.

Certain authors assume that any part of an organised being may set up for itself, and carry on such actions or changes as suits its own ideas of duty, comfort, or prerogative, without the slightest regard to the welfare of the rest of the system.

Thus Beale represents the "germinal matter as *taking on itself* increased growth and multiplication." Moxon, "that the inter-cellular elements *take on* the formation process, the elements if they are rapidly produced are of *evil disposition*."* He requests the students to "Now please observe an important opposition in the *behaviour* of the two sets of elements." Again, "Whenever the tissues of the corium *take on action* then the disease is obstinate and severe." Mr. Maunder "called to mind instances of a lacerated wound of the cheek *taking on* tertiary ulceration." Another author declares that, "uric acid itself and urate of soda are plainly to be expected when the living system is *bent on constructing* uric acid, and at the same time, is not capable of constructing urate of ammonia." Again, dropsy is produced as follows "The lungs *degenerate*" (like modern Greeks) "and *become emphysematous*." Also, Dr. Anton Flora describes a "rodent ulcer *rebellious*" (like the French communists) "under the treatment adopted

Beale.

Moxon.

M under.

A. Flora.

* *Medical Times*. Oct. 22, 1870.

NOTE 1.
T. Fox.
Anstie.

to arrest it." Dr. Tilbury Fox considers that ringworm arises "from a want of *nerve tone*," and on the other hand Dr. Anstie "has proved from a number of observations that chloral excites a steady *toning* influence on the arterial web."

Some old philosophers have imagined that the world was a great animal pursuing his course through the universe at his free will and pleasure, and all known animated beings were merely parasites infesting his dense tegumentary envelope.

Virchow.

Something of a similar hypothesis is entertained by Virchow* as regards each animal, he treats it as though it consisted of a world of separate living beings, each with sensation, thought, and voluntary motion, and having its own opinions as to its special duties. "He is enabled by aid of the microscope to draw boundaries to each cell territory, and advance direct evidence that certain districts of intercellular substance is *ruled over* by the cell which lies in the middle of it, and *exercises influence* upon the neighbouring parts," just as formerly the Emperor of Austria ruled over his hereditary dominions, and exercised influence over the Italian Duchies.

Near the conclusion of his work Virchow speaks thus respectfully of pus, for which surgeons in general never have a good word. He says,† "It" (pus) "is not produced by any special act" (such as secretion) "by any creation *de novo*, but its development proceeds from *generation to generation*" (like a Scotch family of distinction) "in a perfectly regular and *legitimate* manner."

NOTE A.

This teaching of the old Edinburgh School is thus corroborated by the most philosophical physician of the present day.

"Before we can hope to determine conclusively the nature of the changes which constitute disease, or form an accurate conception of the

* Page 15 of translation.

† Page 421 translation.

phenomena occurring in the abnormal or morbid state, we must be able to understand the phenomena which characterise health. We ought to be acquainted with the exact structure of the tissues and organs of the body in the healthy condition before we can appreciate the alterations which have occurred in disease. We must try to discover what goes on when the elements of the tissues are nourished, and what effects, if any, result from the variations in the quantity of nutrient matter sent to the part in a given time. Above all we desire to learn what happens when each individual cell or elementary part of every tissue and organ is nourished normally, and the changes which take place in it when the nutritive process is modified. An accurate microscopic physiology is the necessary precursor of accurate pathology and sound Medicine. Upon no other basis can Medicine be safely built. Hitherto, progress in Medicine has been invariably associated with advance in physiology, and of those who have contributed most to the advancement of Medicine not a few have been eminent as students of physiology. Milne-Edwards has well observed—'La Médecine est un art dont les progrès sont en grande partie dependant de ceux de la physiologie, et qui a sans cesse besoin des lumières fournies par les sciences physiques et chimiques.'" *Lectures on Disease: its Nature and Treatment*, by Dr. Lionel Beale, F.R.S. *Medical Times and Gazette*, June 25, 1870. NOTE A.

NOTE 3.

FROM

RUDIMENTS OF PHYSIOLOGY.

BY

JOHN FLETCHER.

1837.

PART I.—ON ORGANISM.

NOTE 3. The term Physiology signifies etymologically the History of Nature; and it was in this comprehensive sense that it was employed by the ancients in general. By the earlier moderns it was restricted to signify the History of that branch of medicine which relates to the nature and functions of Man; but it has more recently been again extended to include the nature and functions, not only of other Animals, but of Plants also. In this acceptation of the term, Physiology may be defined to be the Science of those actions of Organized beings in which Life consists;* in other words, the

* It appears to be of essential importance that the meanings attached in the following pages to the words "Organized" and "Life," as well as to some others more or less allied to, and therefore liable to be confounded with them, should be from the first precisely defined. How frequently do we find authors, with whom we agree perhaps in fact, perplexing us with propositions to which

Science of Life.* It has been proposed by some late NOTE 3.

we cannot assent, from having attached to the words which they employ meanings totally different from those in which they use them. Nothing, for example, is more common than the proposition, "Life results from organization," and nothing perhaps is less exceptionable than the *fact* intended to be conveyed; but the principal *words* are entirely misapplied—the sentence should have stood, "Vitality results from Organism." The following short glossary will, it is hoped, obviate all ambiguity and misunderstanding on this score in the present instance.

Organ—A part of a plant or animal more or less distinct from the rest, and destined to perform, either alone or in conjunction with others, some specific function.

Organization—The *process* by which a being possessed of organs is formed (*v.g.* the formation of a germ).

Organism, or Organic Structure—The *structure* of a being so formed. [Dr. Barclay is among the very few who have, with great propriety, made this distinction between organization and organism. The title of his Essay therefore, "On Life and organization," has a very different meaning from that of the present Treatise, "On Organism and Life;" the former implying that Life is the cause of the process by which an organized being is formed; the latter, that organic structure is a condition necessary to the manifestation of Life].

Organized—Possessed of such a structure.

Organogenesy—The process by which the several organs become perfectly distinct from each other. (*v.g.* the development of a germ).

Organic—Appertaining to organized beings.

Vitality or Irritability—The property which characterizes organ-

NOTE 3. authors to supersede the term Physiology, by the terms
 ized beings of being acted on by certain powers otherwise than
 either strictly mechanically or strictly chemically.

Life—The sum of the actions of organized beings, resulting directly from their vitality so acted on.

It is constantly in these acceptations that the foregoing words will each be used in the text of the following work; and where a different meaning seems to be attached to them by authors cited in the notes, the sense apparently understood will be at the same time expressed in a parenthesis.

* By Rudolphi and others, Physiology has been defined to be the Science of Organism. An organized being without life is, according to Rudolphi, a thing which cannot be conceived, since organism and life always begin and terminate at the same instant, and exist together in the same degree: the term life then signifies, he says, the same thing as organism. (*Grund. der Physiol.* 1821, I. § 2. and § 209). And indeed if he employ the term organism to signify something, not merely co-existent, but identical with life, the proposition is a mere truism, and the alteration in the definition was only superfluous; but if he employ it, as appears to be the case, to signify organic structure, the proposition is mistaken, and the alteration was vicious. It is not the case, as assumed by Rudolphi and so many others, and among the rest by Adelon, that “le mode de structure, appelé organization, (organisme) et le mode d’activité, appelé vie, existent toujours ensemble;” (*Physiol. de l’Homme*, 1823, I. 31) the error having originated in confounding life with vitality or irritability, a constant attendant indeed on organism, and a necessary condition of life, but still not life itself—not “la vie,” but “l’aptitude à vivre.” Indeed Rudolphi himself appears elsewhere to be aware of the distinction; and describes, not life, but vitality only as co-existent with organism, admitting

Organonomy, Phytonomy, Zoonomy, Bionomy or some other more precisely indicative of the scope and bearings of the science; but this endless introduction, on every frivolous pretence, of new technical terms seems adapted, much less to benefit, than to injure the cause of philosophy.

NOTE 3.

Organized beings then, the characteristic actions of which it is the province of Physiology to investigate, are distinguished from Inorganized matters by certain peculiarities, *in the first* place in their Structure, and *secondly* in their Actions. With respect to their Structure the following may be said to be the principal distinctive marks respectively

that there can be no excitement—that is to say no life—without the requisite stimuli to excite, as well as the requisite susceptibility of being excited; (§ 214) An asphyxized man is not disorganized but he manifests no life; and the Eel of blighted corn—*Vibrio* 1—may continue organized, and retain its vitality for twenty or thirty years; nay the seeds and bulbs of some plants may do so perhaps for a hundred times that period, but without in all that time exercising any one of the functions in the sum of which life consists. Vitality or irritability, resulting as it does from organism, can never fail otherwise than from the destruction of this organism, and the return of the organized being to the state of inorganized matter; but life may fail without any such conditions. It is Anatomy which, as observed long ago by Richerand, is the Science of Organism, while Physiology is the Science of Life.

NOTE 3. OF INORGANIZED MATTERS.

1. A body of an indefinite form, or of one presenting flat surfaces, and bounded by straight lines; of an indeterminate bulk, and without any general envelope.

2. An aggregation of homogeneous parts, no one of which bears any certain relation to the rest.

3. A substance exclusively either solid, liquid or æriform; the particles of which are merely either superimposed upon, or intermingled with each other.

4. A composition each of but few elements, associated into binary compounds; which, as formed by common chemical attraction, are easily imitated artificially, and which are not prone to spontaneous decomposition.

OF ORGANIZED BEINGS.

1. A body of a definite form, (*Individual*) presenting convex or concave surfaces, and bounded by curved lines; of a determinate bulk; and invested by a general envelope.

2. An aggregation of heterogeneous parts, (*Organs*) each of which bears a certain relation to the rest.

3. A substance conjointly solid, liquid and æriform; (*Tissues and Fluids*) the solid particles being as it were, interlaced or interwoven together, and traversed by the fluid.

4. A composition each of several elements, associated, at least after the cessation of their vitality, into ternary or quaternary compounds; (*Proximate Principles*) which, as formed by secretion, are not capable of being imitated by art, and which are prone to spontaneous decomposition.

The characteristic differences between the two great kingdoms of nature are of course the more pronounced, the higher is the rank of any individual organized

being, between which and inorganized matter the comparison is made; but even between the lowest tribes of the former and mere *bruta tellus*, the distinctions, as well in structure as in actions, are still too broad, to allow of our assenting to the speculations of those who represent the two as fundamentally the same.*

* It has nevertheless been frequently made a question whether there be really any precise line of demarcation between inorganized matters and organized beings, and whether the former do not, in fact, slide by insensible degrees into the latter. To say nothing of the alleged identity of their molecular construction—a doctrine not only of many of the ancients, but of Leibnitz, (*Essai de Théodicée* &c. 1720) of Fray (*Sur l'Origine des Corps Org. et Inorg.* 1817) and of some others in modern times—it has been assumed as an axiom by some philosophers that, in the sensible characters of her works, “La Nature ne va point par sauts;” that the law of continuity is maintained from the lowest to the highest of created beings, every thing that exists constituting an essential link between something immediately below, and something immediately above itself in the great chain of creation; and that consequently, all nature being made up of individuals distinguished from each other only by a greater or less degree of advancement, every attempt to arrange them into genera, orders, classes and kingdoms, with certain definite lines of demarcation, must be as unphilosophical as it is futile. Leibnitz accordingly beautifully describes the universe as consisting in “L’unité dans la variété;” but the idea has been inculcated principally by Robinet, who, besides adopting this doctrine, or rather the necessary inference from it, that “tout la matière est organique, vivante, animale,” expressly describes every object in existence, mineral, vegetable and animal, as resulting from the

NOTE 3.

The four distinctive marks then above proposed will repeated efforts of nature, which became only progressively successful, to form man. (*De la Gradation Naturelle des Formes de l' Etre* 1768.) In the course of her progressive improvement, however, she may be easily supposed to have gradually deserted her original plan, and to have left out some materials while she introduced others; so that this wild idea, involving thus the inorganic kingdom of nature in these supposed efforts, is not to be confounded with the more popular recent speculations, either on the progressive formation of the higher tribes of organized beings from the lower at the creation, or on the progressive development of each embryo in its generation, as connected with the subject of the supposed identity of all the tribes of such beings, or with that of the supposed unity of their organic structure, of which we shall speak in future. All those fantastic minerals accordingly which have been called Encephalites, Ophthalmolites, Podolites, Chirites &c. from their rude resemblance to certain parts of the human structure, furnish Robinet with proofs of this long and bungling apprenticeship of nature to the art of man-making; in the course of which the reputedly inorganic kingdom of nature is represented by him as having passed into the organic through the medium of mica, talc and other fibrous minerals, as it has been more recently by Schweigger, (*Handbuch der Naturgeschichte*, &c. 1820) through that of some kinds of corals: but in either case it is quite impossible, it is said, to determine where the one ends and the other begins. Whatever may be thought, however, of the difficulty of discriminating between one form of organized being and another, that of distinguishing any such being from inorganized matter seems to be altogether imaginary. There may be "in this universe a stair, or manifest scale of creatures, rising, not disorderly, or in confusion, but with a comely method and proportion;" (*Religio Medici*,

constitute the subjects of the four Chapters into which this first Part will be divided.

NOTE 3.
Fletcher.

§ 33) but in this stair or scale, as beautifully shown by Dr. Johnson “wherever it begins or ends, are *infinite* vacuities;” (*On the Nature and Origin of Evil*) and however insensible we may sometimes be to these vacuities, as occurring between different forms of organized beings, the gap between the inorganic and organic kingdoms of nature is, at least in general, sufficiently perceptible. Even Bonnet accordingly, one of the most powerful advocates of the doctrine of a graduated scale of bodies, and who does not hesitate to inculcate that

—— “each moss,
Each shell, each crawling insect, holds a rank
Important in the plan of Him who framed
This scale of beings—holds a rank which, lost,
Would break the chain, and leave behind a gap
Which Nature’s self would rue,”

admits, that in passing from inorganized matters to organized beings, “la nature semble faire un saut;” (*Sur les Corps Organ.* 1762) and, as remarked by Prichard, “no analogy can here be traced except what is vague and chimerical.” (*On the Vital Principle*, 1829.)

NOTE 4.

Latham. From Latham's *Elementary English Grammar for the use of Schools*.
 Twenty-first thousand. Walton, 137 Gower Street, London.
 PART III. ETYMOLOGY.

NOTE 4. One, then, of the functions of Grammar is, to *represent Language as it exists* ; language being a fact which we must take as it is found.

§ 64. We now come to four new terms, that mutually illustrate each other. They run in pairs: (1 and 2,) *Substance and Attribute* ; (3 and 4,) *Abstract and Concrete*.

Take (for instance) an orange. It strikes our senses. We see with our *eyes* that it is more or less *round* *i.e.* that it is endowed with the *property or quality of roundness*. We see, too, that it is more or less *yellow*, *i.e.* that it is endowed with the *property or quality of yellowness*. We see that it is more or less *smooth*, *i.e.* endowed with the *property or quality of smoothness*. Our eyes tell us all this; the sight being the sense by which our belief as to the properties in question is conveyed to us. They tell a great deal more; but this it is unnecessary to enlarge on.

Then comes the evidence of our other senses.

By our *ears*, we detect a sound if we rub the skin with our fingers.

We *smell* it and find a peculiar and not unpleasant aroma.

We *taste* it and are gratified with a not unpleasant flavour.

We *feel* that it is elastic, or endowed with the attribute of elasticity. We feel, too, that it has a certain figure and size. We feel, too, that it has a certain weight.

On the strength of all this we say that an orange is *round, yellow, smooth, capable of exciting sounds, fragrant, sapid, elastic, &c.*

When we say that an orange is this, we *attribute* to it certain properties, or qualities. What are they? The qualities, or properties, of *roundness*, *yellowness*, *smoothness*, *sonorousness*, *fragrancy*, *sapidity*.

NOTE 4.
Latham.

And how do we speak when we say that we do so? It is convenient to begin with saying how we do *not* speak. We do *not* say that an orange has the property of round, yellow, smooth, &c. On the contrary, we say that it has the property of *round-ness*, *yellow-ness*, *smooth-ness*, &c.

So much for the attributes of an *orange*; at least, for some of them. The attributes of a *guinea*, a *loaf*, a *man*, a *fish*, or anything else, may be considered in the same way. They are, of course, when taken altogether, different from those of an orange. The principle, however, of considering them is the same.

Let us now suppose that all these attributes are, one by one, taken away, *and replaced by others*; that instead of an orange striking our eyes and sense of touch as round, it strikes them as square, or rhomboid; that it loses its fragrance and becomes fetid; that it sounds like a bell, and tastes like a loaf of bread. Would the object still be an orange? Would it not be something else? This leads to the question of the *essential* attributes or *essences* of things. Never mind them for the present; but put your thoughts in a somewhat different direction.

Divest the orange of all its attributes *without supplying it with new ones*. What will it be then? Take away its original colour without replacing it by any fresh one. Let it lose its softness without becoming hard, its roundness without becoming of any other form. Annihilate its weight, taste, and smell. Let it have no means of appealing to eye, ear, taste, smell, or touch, so that it become, at one and the same time, impalpable, invisible, imperceptible. What will it be then? Will it be anything at all?

NOTE 4.
Latham.

What becomes of the attributes? We have seen that they were taken away. What was done with them? They were taken away *separately*, and it is separately that they are put aside. *Roundness* and *yellowness* no longer go together. Each is in its own place; and that is a place by itself. No link now unites them; the orange in which they met being no more.

But we may unite them afresh; say in the idea of a golden ball, a guinea, a full moon, &c. And we may also separate them, again and again. United, they give the idea of an object clear, palpable, sensible. Separated, or abstracted from those objects, they do nothing of the kind. Yet the mind takes cognizance of them. The idea of the particular attribute of yellowness, abstracted from an orange, is not much more difficult than the idea of the orange *minus* the attribute of yellowness. It is merely a case of difference and remainder; the additions and subtractions being made unconsciously and instinctively.

What becomes of the orange? Is it annihilated by the abstraction of its attributes, one and all? Few are prepared to say *yes* to that question.

Few divest themselves of the notion that sensible, and material objects are nothing more than the combination of certain properties, qualities, and attributes, each and all of which may be removed in such a way as to leave an absolute nothing.

We rather imagine that, where there are certain attributes in union, there is a certain link which connects them; a basis, or foundation, which supports them; a basis, or foundation, different from the attributes themselves, but upon which they rest.

This *something* supports them. This something stands *under* them. This something is the *sub-stance*, or *under-standing*, of objects opposed to, and contrasted with, their *attributes*. Now

Concrete terms are the names of Substances; whilst Abstract terms are the names of attributes; *e.g.*:—

NOTE 4.
Latham.

ABSTRACT.		CONCRETE.
Brightness,	are Attributes of the Substances	Sun.
Heat,		Fire.
Light, &c.		Spark.
Mortality,		Animal.
Vitality,		Man.
Animality,		Horse.
Solidity,		Wood.
Resistance, &c.		Stone.
Fluidity, &c.		Water.

Vice Versa.

CONCRETE.		ABSTRACT.
The Sun,	are Substances with the Attributes	Brightness.
Moon,		Heat.
Stars, &c.		Warmth.
Man,		Mortality.
Horse, &c.		Animality.

NOTE 5.

From Dr. Beale's *Mystery of Life*, p. 53.

"Dr. (Sir William) Gull, like many who disapprove of the *vital theory*, admits that he cannot fully explain vital phenomena. Vitality is then after all a mystery. But some of us are convinced of the truth of facts which justify us in concluding that the mystery is to be accounted for only by supposing *an agency, force, or power*, of an order different from that in which the forces of the non-living world are included; while others maintain that life will eventually prove to be but another mode of the ordinary forces of matter.

NOTE 5.
Beale.

NOTE 5.
Beale.

For my part I am ready to abandon altogether the idea of vitality, and to dismiss it with other ideas, considered by the new school as mere prejudices imbibed during the irresponsible state of childhood, as soon as convincing evidence of error shall be adduced; but I refuse to give up these for the threats or gibes of a school whose tenets rest upon the mere authority of modern assertion, and whose forcible dicta, however determined and arrogant, are justified neither by reason, nor by observation, nor by experiment."

NOTE 6.

NOTE 6.
Locke.

Locke reflects on the application of old words in a new and unusual signification without defining them. "In this abuse the schools have been most remarkable, and have done philosophy the greatest injury. The absurdity of their doctrines necessarily led to this; for there is no more effectual way of defending strange and absurd doctrines than to guard them round by legions of obscure, doubtful, and undefined words, which make these retreats more like the holes of foxes, or dens of robbers, than the fortresses of fair warriors; which, if it be hard to get them out of, it is not from the strength that is in them, but the briars, and thorns, and the obscurity of the thickets which beset them.

Neither is there any ingenuity displayed in this abuse of language, no more than there would be in writing a book in which the signification of the letters of the alphabet should be changed A for B, and B for A, D for C, &c."

NOTE 7.

NOTE 7.
Huxley.

Professor Huxley uses scientific words in this uncertain manner and habitually confounds property, power, and function.

The greatest part of his *controversy* with Dr. Lionel Beale has arisen from this uncertainty in the meaning of his words.* NOTE 7.

These disputants really differ more in the use of the words Vitality, Power or Stimulus, and Function or Life, than in their belief in the properties, nature, and condition, of animated beings.

Professor Huxley sometimes assumes that a *power* and a *faculty* are identical, at others he mentions that a property such as *contractility* of itself may give rise to motion, and again that vital actions are the *properties* of living matter, and even the function of *Thought* is put down as a property of the material that thinks.† Huxley.

* From Professor Huxley in his *Physical Basis of Life*.

"But I propose to demonstrate to you that, notwithstanding these apparent difficulties, a threefold unity, namely, a unity of *power or faculty*, a unity of form, and a unity of substantial composition, does pervade the whole living world."*

(In this passage power and faculty are treated as identical and the word *unity* is employed to mean *similarity* in which sense the assertion is correct.)

"No very abstruse argumentation (*sic*) is needed, in the first place, to prove, that the *powers or faculties* of all kinds of living matter, diverse as they may be in degree, are substantially similar in kind.

† "The protoplasm of Algæ or Fungi becomes, under many circumstances, partially, or completely, freed from its woody case, and exhibits movements of its whole mass, or *is propelled by the contractility* of one or more hair-like prolongations of its body which are called vibrated Cilia."†

(Here it is obvious the Professor means *contraction* by the word contractility, as mobility could never of itself cause motion, although on the application of a power motion would result.)

"And so far as the conditions of the manifestation of the *phenomena of contractility* have yet been studied, they are the same for the plant as for the animal."

(It is obvious however that contractility, any more than combustibility, can *manifest no phenomena*. We observe the phenomena of

* *Physical Basis of Life*. Page 134.

† *Ibid*. Page 138.

NOTE 7.
Huxley.

Professor Huxley's use of the word *identical* is equally loose and uncertain although upon that word a great portion of his argument depends.)

He asserts that the substance of various living bodies which may be miles apart is *identical*, but yet he acknowledges that the properties of these different identical bodies may differ very greatly, as in the case of the inanimate material of the boiled lobster, and that of the thinking and speaking Professor.*

Although Professor Huxley, as quoted by Beale, asserts that "Vitality can be neither weighed, measured, nor scientifically proved to exist," and is therefore a mere figment of the imagination, yet in his essay on the Physical Basis of Life, he virtually concedes the question.

By the "physical basis of life" he means to assert that there is some kind of matter common to all living beings.†

contraction or combustion, but the abstract qualities of contractibility and combustibility are mere inferences of our minds.)

"It may seem a small thing to admit that the dull *vital actions* of a fungus, or a foraminifer, are the *properties* of their protoplasm, and are the direct results of the nature of the matter of which they are composed."

(Here the functions of a living being are confounded with its properties.)

* "But if, as I have endeavoured to prove to you, their protoplasm is essentially *identical* with, and most readily converted into, that of any animal, I can discover no logical halting-place between the admission that such is the case, and the further concession that all vital action may, with equal propriety, be said to be the result of the molecular *forces* of the protoplasm which displays it."*

(Here the word force is employed for property, as action depends upon the property of the acting body when excited by an external power).

† "And if so it must be true in the same sense, and to the same extent,

Professor Huxley does not use the word *life* as an abstract term signifying the "sum of the actions of organized creatures," but as a common term to include all animated beings in one class; and by "matter or basis of life common to these beings" he means some material the essential foundation of such beings, the properties of which are similar in every instance.

NOTE 7.
Huxley.

But he repeatedly asserts that living beings display "vital actions" and "vital phenomena."

Now in whatever way vital actions may be defined, it is obvious that the subjects of such actions possess that quality called *vitality*, just as the matter, the subject of motion or combustion must possess mobility or combustibility.

All that Brown and Fletcher mean by *vitality* is that quality which is characteristic of organized beings and in virtue of which they display vital phenomena, and by which they are distinguished from all inorganic material of the world.

that the thoughts to which I am now giving utterance, and your thoughts regarding them are the *expression* of molecular changes of that matter of life which is the *SOURCE* of our other vital phenomena."*

By "matter of life" Professor Huxley means the essential matter of living animals, which matter or protoplasm is the subject, but certainly not the *source* of vital phenomena. A grain of wheat retains its protoplasm intact for a hundred or a thousand years, but displays its characteristic vital phenomena only when light, heat, and moisture, excite its inherent vitality into action. These external agents are the *sources* of the vital action.

"At any rate, the matter of *life* is a veritable *peau de chagrin*, and for every *vital act* it is somewhat the smaller. All work implies waste, and the work of *life* results, directly or indirectly, in the waste of protoplasm.†"

"I might sup upon lobster, and the *matter of life* of the crustacean would undergo the same wonderful metamorphoses into humanity."‡

* Page 152. *Physical Basis of Life*.

† *Ibid.* page 145.

‡ Page 146.

NOTE 8.

FROM

RUDIMENTS OF PHYSIOLOGY,

BY

JOHN FLETCHER. 1837.

ON THE DIRECT STIMULI TO IRRITABILITY.

NOTE 8.

IRRITABILITY is only one of the conditions necessary to Life—it is only, as it were, the susceptibility of living, or, as the French call it, *l'aptitude à vivre*—and other conditions are still requisite in order to give rise to those phenomena in which Life, consisting as it does in the sum of the essential functions performed by organized beings, consists.

These Stimuli may be spoken of as either Direct and Primary, or Indirect and Secondary; the former acting *ab initio* on the irritability of the organs to which they are applied; the latter implying always a previous irritation of some one organ—no matter by what means excited—and consisting in a translation of this irritation, so as to act on the irritability of organs at a distance. Thus a pinch of snuff, applied to the schneiderian membrane, excites *ab initio* an irritation in that organ, indicated by the changes effected in its secretions; and this irritation may either go no further, or may be translated by sympathy to the abdominal muscles, and excite there a secondary irritation, indicated

NOTE 8.
Fletcher.

by the sneezing which so often follows. Snuff therefore is an example of a direct and primary stimulus to irritability, and sympathy, an example of an indirect and secondary one. It is of importance to remark, however, that these stimuli are not, any more than the irritability on which they act, substantial, although, like irritability, they are necessarily attached to something that is so; and such substances accordingly, in the case of the direct and primary stimuli, are, for the purpose of avoiding circumlocution, always put for the stimulus of which they are at once the source and the vehicle. It is obvious that, if Life be a non-entity, neither of its conditions—neither irritability nor any stimulus by which irritability is excited—can be entities. When we say therefore that snuff or any other substance is a stimulus to irritability, we mean only that the substance in question possesses some power which acts in this capacity; and we specify the substance only as a summary way of indicating the power which it exercises. We recognise these powers, as we recognise the property on which they act, only by their effects—we know nothing of them abstractedly. They are, in every case, the result of the peculiar aggregation of matter in which they reside, in the same way as irritability is the result of organism; but they are certainly no more identical with the substance of which they are characteristic, than irritability is identical with the organized tissues of which it is the attribute.

NOTE 8.
Fletcher.

Of the Direct or Primary Stimuli to irritability, the chief are certain universally diffused agents, to which organized beings, in common with inorganic matter, are more or less constantly exposed, such as CALORIC, LIGHT and ELECTRICITY; others, of which they continually appropriate a portion to themselves, such as the medium by which they are directly surrounded, whether AIR or WATER, and the solid and liquid substances which they use as ALIMENT; and others lastly which constitute at all times a substantial part of themselves, such as their various FLUIDS, whether crude, mature or secreted. Of the Indirect or Secondary Stimuli, the principal are SYMPATHY and PASSION or INSTINCT—the two latter of which appear to be merely varieties of the former—and VOLITION. In addition to these, which may be regarded as more or less constant and salutary Stimuli to irritability, and which, when neither excessive nor defective, constitute what may be called the *Exciting causes of HEALTH*,* certain others occasionally come into operation, the action of which, as well as that of any of the preceding, when either in excess or deficiency, is prejudicial, and it is of these that the *Exciting causes of DISEASE* consist; but with these we have nothing to do at present.

* At the time when it was customary to regard Life as something inherent in the living body, and *per se* competent to bring about all vital phenomena, it was the practice to speak of every

NOTE 9.

As regards our knowledge of cause and effect the Archbishop of York thus expresses himself: NOTE 9.

thing relating to the structure and actions of the body, under the name of *Naturals*, of which seven were generally admitted—namely, its Organs, its Tissues or Associations, its Fluids, its Principles, its Properties, its Powers and its Functions—the first five of which have been already spoken of in the order in which they are above enumerated. The error of this schedule consisted in including the powers and functions of the body, which were represented as inherent in it, like all the rest, instead of the powers being regarded as more or less adventitious agents, from the co-operation of which with the characteristic property of the body—i. e. irritability—the functions resulted. This however would have been to deprive the everlasting Vital Principle of its self-sufficiency; and consequently all those agents which the patrons of the Vital Principle doctrine could not avoid observing very materially influenced vital phenomena, and should have been included under the head of the adventitious powers aforesaid, were regarded as quite accidental, and marshalled accordingly into a distinct phalanx, under the name of *Non-naturals*, of which it was customary to admit six to wit, Air, Aliment, Exercise, the Secretions, the Passions and Sleep. Upon what principle the most natural things in the world, as remarked by Sterne, should ever have been called non-natural remains unexplained; but a remnant of this ancient absurdity is still perceptible in the advice sometimes even yet given to valetudinarians, to take care of their non-naturals. It was reserved for John Brown to abolish this non-natural and unfounded distinction, by demonstrating that Life, and of course all the functions of the body in the sum of which Life consists, depended solely on the operation of

NOTE 9.

“All knowledge is experience of facts acquired by the senses. The traditions of older philosophies have obscured our experience by mixing with it much that the senses cannot observe, and until these additions are discarded, our knowledge is impure. Thus metaphysics tell us that one fact which we observe is a cause, and another is the effect of that cause; but upon a rigid analysis we find that our senses observe nothing of cause or effect: they observe, first, that one fact succeeds another, and after some opportunity, that this fact has never failed to follow—that for cause and effect we should substitute invariable succession. An older philosophy teaches us to define an object by distinguishing its essential from its accidental qualities; but experience knows nothing of essential and accidental; she sees only that certain marks attach to an object, and after many observations, that some of them attach invariably, whilst others may at times be absent....

As all knowledge is relative, the notion of anything being necessary must be banished with other traditions.”* Old pupils of Fletcher will recognize these ideas.

Mill.

Again, James Mill says, in his *Analysis of the Human Mind*, “Names to mark the antecedent and consequent in all constant

some of these non-naturals, in conjunction with many other agents more or less allied to them, but which the founders of this distinction, in the plenitude of the perplexity in which their untenable hypothesis respecting Life involved them, had inadvertently omitted. But it is idle entering into any investigation of the merits of a system, which is not less loose and arbitrary in its detail, than it is, in its general principle, opposed to everything like reason and common sense.

* *The Limits of Philosophical Inquiry*, page 4.

successions were found indispensable. Cause and effect are the names we employ. In all constant successions, Cause is the name of the antecedent, Effect the name of the consequent. And, besides this, it has been proved by philosophers that these names denote absolutely nothing.”* The writer adds in a note that this has been proved “chiefly by Dr. Brown, of Edinburgh, in a work entitled” *Inquiry into the Relation of Cause and Effect*, “one of the most valuable contributions to science for which we are indebted to the last generation.”

NOTE 9.
Mill.

Brown.

Now it may be observed, as one example of the fertility of Hume’s mind, which, like Hobbes’s, often threw out in a sentence or two, and in the course of other enquiries, new ideas which might have formed the subject of volumes, that Hume, in the eighth section of his *Enquiry concerning the Human Understanding*, a section on the subject of ‘Liberty and Necessity,’ has expressed in a single paragraph the conclusions of Brown’s ‘*Inquiry into the Relation of Cause and Effect*.’ ‘It seems evident,’ says Hume, ‘that if all the scenes of nature were continually shifted in such a manner that no two events bore any resemblance to each other, but every object was entirely new, without any similitude to whatever had been seen before, we should never, in that case, have attained the least idea of necessity, or of a connection among these objects. We might say, upon such a supposition, that one object or event has followed another, not that one was produced by the other. The relation of cause and effect must be utterly unknown to mankind. Inference and reasoning concerning the operations of nature would from that moment be at an end; and the memory and senses remain the only canals by which the

Hume.

* *Analysis of the Phenomena of the Human Mind*. Vol. ii. p. 37. London, 1829.

NOTE 9. knowledge of any real existence could possibly have access to the mind. Our idea, therefore, of necessity and causation, arises entirely from the uniformity observable in the operations of nature, where similar objects are constantly conjoined together, and the mind is determined by custom to infer the one from the appearance of the other. These two circumstances form the whole of that necessity which we ascribe to matter. Beyond the constant *conjunction** of similar objects, and the consequent *inference* from one to the other, we have no notion of any necessity of connection.†

I think that this amounts precisely to the conclusion above expressed by James Mill, as proved by Brown, that, in all constant successions besides this, Cause is the name of the antecedent, Effect the name of the consequent, the words Cause and Effect denote absolutely nothing.”

Taken from *Essays on Historical Truth*, by Andrew Bisset, page 143, London: Longmans, Green, & Co., 1871.

NOTE 10.

Consisting of extracts from a pamphlet on *Life and the equivalence of Force*. By J. Drysdale, M.D. Turner and Co. Fleet Street.‡

NOTE 10.
Drysdale.

As this paper, besides its intrinsic merits, is of historical interest I give here an abstract of it.

§ 2. He begins with the proposition “Forces are causes, and in

* The two words “conjunction” and “inferences” are in italics in the original.

† Hume’s *Essays*, vol. ii. pp. 82, 83, Edinburgh 1825.

‡ This note may be skipped without loss to the subject matter of the treatise.

NOTE 10.
Mayer.

respect to them, the axiom *causa æquat effectum* finds full application." In a chain of causes and effects no link can be wanting, hence the first property of all causes is their indestructibility.

If one link, say *c*, has produced an effect equal to itself *e*, it ceases to exist as *c*, and so on through the whole chain. Therefore, all these quantitatively equal links must be regarded as different forms of the same object. "The power of taking on different forms is the second essential property of all causes.

Professor Bohn and Dr. Akin have given interesting papers in vol. xxviii, IV, of the *Phil. Mag.*, on these anticipations. In particular the latter gives a quotation from an article by Mohr, of Coblenz, in 1837, where he says the force of the arm in turning the electro-magnetic machine re-appears as heat, light, chemical affinity, and magnetism. This anticipates a passage from Joule. And "what produces a force must itself be a force. What counteracts a force must itself be a force. Heat appears in innumerable cases as a force." These expressions are in various places paralleled in Mayer's book.*

Both properties being comprehended, we say causes are (quantitatively) indestructible, and (qualitatively) convertible objects." But there are two divisions of causes in nature, between which no transference can occur, viz. those possessing impenetrability and weight, *i.e.* material, and those without, *i.e.*, the imponderable forces. "Forces are therefore *indestructible, convertible, imponderable objects.*"†

For it is also a part of the doctrine in question that all forms of

* "The force of the arm," here a *motion* or *action* of matter, is spoken of as a *force*.

† "Some causes are material and some imponderable." "As all causes are forces." Some forces are matter and some forces are not material but still are objects.

Here *forces* are confounded with matter.

NOTE 10.
Mayer.

force or energy are mutually convertible, but, practically, the final result of all such transformations is into *heat* or *light*. These, as is well known, are perpetually radiating into the surrounding medium; and hence, with the exception of such portions as are absorbed by plants and chemical action the tendency is finally to be dissipated into space.

A cause which brings about the raising of a weight is a force; its effect (the raised weight) is, accordingly, equally a force; or, expressing this relation in a more general form, *separation in space of ponderable objects is a force*; since this force causes the fall of bodies, we call it *falling force*.*

Falling force and fall, or, more generally still, *falling force* and *motion* are *forces* which are related to each other as cause and effect—*forces* which are convertible one into the other—two different forms of one and the same *object*.† For example, a weight resting on the ground is not a force; it is neither the cause of motion, nor of the lifting of another weight; it becomes so, however, in proportion as it is raised above the ground: the cause—the distance between a weight and the earth—and the effect—the quantity of motion produced—bear to each other, as we learn from mechanics, a constant relation. Weight being regarded as the cause of the falling of bodies, gravitating force is spoken of, and so the notions of *property* and of *force* are confounded with each other; precisely that which is the essential attribute of every force—the *union* of indestructibility with convertibility—is wanting in every property; between a property and a force, between weight and motion, it is

* “Separation in space of ponderable objects is a *force*,” here a condition of matter is spoken of as a force.

† Dr. Hughlings Jackson entertains very similar opinions of the material nature of *force*. He alludes to the *absorption*, expenditure and distribution of *force* in the human body. *Brit. Med. Journal*, 1873, p. 531.

therefore impossible to establish the equation required for a rightly conceived causal relation.*

NOTE 10.
Mayer.

If weight be called a force, a cause is supposed which produces effects without itself diminishing, and incorrect conceptions of the causal connection of things are thereby fostered. In order that a body may fall, it is no less necessary that it should be lifted up than that it should be heavy, or possess weight; the fall of bodies ought not, therefore, to be ascribed to their gravity alone.†

* Here it is assumed that a Power of one substance cannot be a Property of another, but Lardner thus talks of the attracting power of the Earth, "The globe we inhabit participates in this common *property*. It therefore exercises an attraction on all bodies placed on or near its surface."

Lardner.

Again, he says, "The moving mass of a hammer head will exercise a *force* upon a nail sufficient to make it penetrate wood, an effect which no common pressure could produce."

Here it is obvious that a subjective *property* becomes objectively a *power* and therefore Mayer defines the word Power differently from writers on mechanics. Page 85, of *Mechanics*.

† As these words, Force, Power, Energy, are continually used by physiologists, it may be worth while to ascertain their meaning in the writings of mechanics.

S. Newth defines Force to be "whatever is capable of producing motion in a body, or any change in the motion of a body is termed *force*. In other words, *force* is the name we employ to express that *unknown cause* which under any circumstances, can produce a change in the state, whether of rest or motion of any material body. All statical forces may be measured by weight."

Force.
S. Newth,
p. 23.

"The *weight* of a body is the total *force* with which that body is drawn towards the earth: it is therefore the same as the resultant of the *forces* which in consequence of the existence of gravity, act upon its small particles."—*Samuel Newth*. Fourteenth thousand. p. 23.

Lardner also adds: Weight is the kind of *Force* with which we are most familiar.

NOTE 10.
Mayer.

But the question was still undetermined with respect to the other natural forces—heat, electricity, magnetism, and *chemical action*. Did the same law apply here; and what was the real relation between them and mechanical motion, which they can all produce?*

Motion is latent heat, and heat is latent motion A special application of this general principle is the well-known law of Dulong that the amount of heat which is obtained by the compression of the gases is dependent on the force expended alone, and not upon the chemical nature, nor the temperature, nor the tension of these gases."† (Page 283.)

The celebrated English physicist, Joule, was led to the axiom that the phenomena of heat and motion rest essentially on the same principle, or, as expressed by him as well as myself, that *heat and movement* are mutually convertible.

From the compression experiments he obtained 823 and 795 foot-pounds. These, he says, were so near the 838 lbs. of the 1843 paper, in which "latent heat" could not be suspected, that he is

All forces may be estimated by the amount of *weight* to which they are equal. *Mechanics*, p. 16.

Hence Mayer used the words, weights and force, differently from writers on Natural Philosophy.

Mitchell. Dr. Arthur Mitchell in the *Edinburgh Medical Journal* for Dec. 1871, remarks—

"In these papers a state of mind has often been spoken of as the *Cause* of a state of body, or *vice versa*; but the cause, of course, had in its turn a cause, and so on backwards, to what, we cannot often tell. It seems desirable, therefore, to point out that, in speaking of *causes* here, little more is meant than *related antecedents*. We have, indeed, not yet travelled far beyond this, but the journey we have made may nevertheless be important and productive of useful discovery."

* *Chemical action* is therefore a force and consequently an *object*.

† Health is latent exercise and exercise is latent health on similar principles, and therefore health and exercise are mutually convertible.

confirmed in the theory "that the heat was the manifestation in another form of the *force* expended in the act of condensation." (page 375.)

NOTE 10.
Mayer.

He then goes on adducing other examples, showing by the disappearance of heat and arising of motion the apparently causal relation between them, and among other remarks has this: "The locomotive with its train may be likened to a distilling apparatus; the heat under the boiler is converted into motion, and that again is given back in the axles and wheels as heat.

Now, does the mechanical effect yielded by the five horses vanish into nothing in the machine? The fact speaks—*it becomes heat.*" (Page 37.)

This relation of the two specific heats of gases is, therefore, one of the most perfect means of demonstrating and measuring the conversion of heat into work.

Certainly with the fact of radiation of heat known to all the world, when once the transformation of the forces was discovered, the dissipation of energy became such an obvious corollary that one would scarcely have expected to see it put into such a position.

§ 3. Such is the now celebrated original essay of Mayer. It is very short, occupying barely twelve pages. As might have been expected from the preliminary train of thought we have indicated, it approaches the subject from fundamental philosophical principles. It first distinguishes between the inherent *properties* and the *forces* of matter, defining the latter as indestructible, equivalent, and convertible objective existences, the proof of this being made to hang on the exact numerical relation between heat and movement.* †

J. Drysdale.

* *Life and the Equivalence of Force*, by J. Drysdale, M.D. Page 19.

† Lardner, however, (like other people) says, "a body falls by the *Force* of gravity which is a *property* of the Earth, that is, the *power* of attracting other bodies is a *property* of all matter"; or again, "Gravity

NOTE 10.
J. Drysdale.

Then he says, mentioning Mayer for the first time, "In 1834 Dr. Faraday demonstrated the 'identity of the chemical and electrical forces.' This law, along with others subsequently discovered by that great man, showing the relations which subsist between magnetism, electricity, and light, have enabled him to advance the idea that the so-called imponderable bodies are merely the exponents of different forms of force. Mr. Grove and M. Mayer have also given their powerful advocacy to similar views.

Mayer.

This train of reasoning has already been given in § 2 and may be said to culminate in the axiom, *Causa æquat effectum*. If in mathematics and metaphysics this may be regarded as a mere truism, yet when applied to the physical forces, and conjoined with the axiom that every such cause (*i.e.* force) is expended or put out of existence in the exact ratio of the effect it produces or the work done; in other words, is transformed into it; then it becomes a most fruitful principle. By means of it Mayer concluded that in the case in point, where work was done by expansion under constant pressure, an equivalent amount of the cause of that work, *i.e.* heat, must be consumed; not remaining combined with the expanded gas, to be given out undiminished in the condenser, as Carnot and the rest supposed. This was confirmed by the counter experiment of expansion *in vacuo*, where no work being done, no heat is consumed. Here the work was already done when the air was pumped out beforehand, and you no more require the same work to be done twice than you can get the same work twice over out of any power such as waterfall, fuel, or gunpowder. Mayer's conclusions have been confirmed to the very letter by subsequent

acting on bodies near the surface of the earth is an uniformly accelerating force"; the force of gravity, &c.; the force of gravity a cause of motion, &c. Page 89, *Mechanics*.

experiments of others, and the general progress of physical science.*

NOTE 10.
Mayer.

We perceive now that the grand general bearing of the subject has begun to dawn upon his mind. He passes at once to the science of physiology, and noticing that Haller attempted to ac-

* PHENOMENA AND FORCES.

Hime.

Abstract of a paper read at the last meeting of the Natural Science Section of the Sheffield Philosophical Society by the President, DR. HIME.

The profoundest investigation into the nature of matter ever leaves utter dissatisfaction in the human mind; the finite thought, able to speculate on, and yearning to know the infinite, but ever driven back within the narrow limits which bound man's mental. Whence did we get the idea of the infinite? we who can so little apprehend the finite. Even what actually comes under our observation can be known to us only relatively. Of "*things as they are*" we know nothing; indeed much energy has been expended in discussing whether there is anything behind phenomena, any material substratum. False methods of inquiry, misuse of words, and religious intolerance, have greatly retarded the acquisition of knowledge throughout the world. The innate tendency to assign to super-human agency the cause of every unaccountable occurrence, and in general to invent *causes* when *conditions* only are known, readily leads men to believe that there are *forces* distinct from *matter*, *forces* which, operating on the "*brute matter*," produce phenomena. But the idea of matter is a pure abstraction, and equally so is that of force. Physical or material objects are known to us only through the medium of our senses. The PROPERTIES of matter are the POWER it possesses of producing certain sensations, But there is no such thing as matter stripped of all its properties. To assume the existence of properties apart from the bodies which exhibit them is to endow an abstraction with existence. Of the causes of our sensations we know absolutely nothing, we have cognisance only of certain alterations produced within ourselves," or, as Kant puts it: "What may be the nature of objects considered as things in themselves, and without reference to the receptivity of our sensibility, is quite unknown to us."

NOTE 10.
Mayer.

count for the portion of animal heat that Crawford's hypothesis left unexplained, by the friction of the blood in the blood-vessels, he observes :—

“It is unquestionable that heat is produced by such friction, but it must be understood that the mechanical force expended in the friction is a part of the force of affinity which causes the venous blood to unite with oxygen, so that the whole heat of the system must still be referred to the chemical changes. But if the animal was engaged in turning a piece of machinery, or in ascending a mountain, I apprehend that in proportion to the muscular effort put forth for the purpose, a *diminution* of the heat evolved in the system by a given chemical action would be experienced.”

Drysdale.

It is very interesting that a similar train of thought occurred to Mayer at the very first, when he noticed the red colour of the venous blood at Batavia, as may be seen at § 1, where the total force of both heat and work are referred to oxidation. With regard to the loss of heat on ascending a mountain, it is certainly a very remarkable example of correct scientific deduction in opposition to common observation. We all know the effect of exercise in increasing the activity of the circulation and respiration, and all those functions comprising the *opus vitale* resulting in increase of animal heat. This under ordinary exertion, and even the ascent of a moderate elevation, especially when *not* fasting, more than counterbalances the loss of force given out as work.

Therefore, though some vital processes are independent of oxidation, yet it is essential to maintain the average amount of force, and as no kind of transformation can possibly equal the disengagement of force due to oxidation down to binary compounds, it becomes the absolute measure of the disengagement of force in the living body, and the law is thus expressed: viz. the quantity of *vis viva* developed (permanently) by the living body must be equal

to the difference between the heat of combustion of the food and the heat of combustion of the excretions.

NOTE 10.
Mayer.

This confirms also another remark of Mayer's that in delirium, epileptic convulsions, and in the tricks of jugglers in which muscular action takes place, without doing real work, little expenditure of force takes place, and in trismus almost none. So the effect comes out as heat (p. 123). We know also that in the state of rest muscles develop a current of electricity which is immediately brought into equilibrium, and most likely becomes heat; but as the muscle becomes active the electricity diminishes, and on full action ceases altogether. We thus again see the reciprocity of work and other forms of *vis viva*. Here, as elsewhere, when phenomena are found difficult of explanation, electricity has been conjectured to be the intermedium of the change of chemically evolved force into work, but no proof has as yet been offered. We sometimes also hear it loosely stated that the animal heat is converted into the mechanical work in the muscles. Mayer gives no countenance to such a mode of expression; and he merely speaks of heat in the *status nascens* being so used, implying the force or energy which might or would become heat if not otherwise used. It happens, as Fick remarks, that we can positively prove that the muscles are incapable of producing mechanical work from heat in the manner of a thermo-dynamic engine. For we know that of the total heat producible by the animal body, one-fifth can be converted into work.

Mayer next, with extreme ability, deduces three important propositions by means of the quantitative relations of the chemical changes and evolved *vis viva*. In these, although he does not anticipate all the discoveries in matters of detail which have been since made, yet he maps out the boundaries within which the truth must lie.

The main point in any theory is to account for the quantity of

NOTE 10.
Mayer.

vis viva evolved even if we cannot show the method of the conversion of it into work which is not done here, and in all theories that still remains hidden. The weak point in this chemical theory is also to explain the action of the stimuli which we cannot understand as producing even the necessary decomposition, far less the oxidative synthesis of the inogen. We can, therefore, easily conceive these to produce the oxidative synthesis of the inogen, or any similar substance whose splitting up is to furnish the needful *vis viva* for muscular functions. At the same time, by a perfectly independent process, though simultaneous, the products, viz. carbonic and lactic acids, &c., are absorbed into the capillary veins.*

‘Assuming that the expansion of elastic fluids on the removal of pressure is owing to the centrifugal force of revolving atmospheres of electricity, we can easily estimate the absolute quantity of heat in matter. For in an elastic fluid the pressure will be proportional to the square of the velocity of the revolving atmospheres; and the *vis viva* of the atmospheres will also be proportional to the square of their velocity, consequently the pressure will be proportional to the *vis viva*. Now the ratio of the pressures of elastic fluids, at the temperatures of 32° and 33°, is 480 to 481, consequently the zero of temperature must be 480° below the freezing point of water.’ (*Phil. Mag.*, III, vol. xxvii, p. 207).

Afterwards, as we shall find, he abandons the hypothesis of electric atmospheres, but applies these calculations to the motions of the molecules themselves, and gives their actual velocity.

From our own experiments on the combustion of a mixture of hay and corn in oxygen gas, we find that each grain of food, consisting of equal parts of undried hay and corn, is able to give 0.682° to a pound of water, a quantity of heat equivalent to the raising of a weight of 557 lbs. to the height of a foot. Whence it appears

* Here *Vis viva*, which is something added to and controlling matter, is spoken of as a *force*.

that one quarter of the whole amount of *vis viva* generated by the combustion of food in the animal frame, is capable of being applied in producing a useful mechanical effect, the remaining three quarters being required in order to keep up the animal heat, &c." NOTE 10.

NOTE ON THE NATURE OF FORCE IN MENTAL PHENOMENA.

From *The Saturday Review*. February 8, 1873.

A curious paper might be written on the singular errors made by men of high reputation in their critical judgments. Something of the kind was lately done in one of the magazines. Instances of such blunders abound since people first began to cultivate the art.

*Saturday
Review.*

If criticism should ever rise to the dignity of a science, such mistakes will be impossible. We shall discover some infallible gauge of literary merit, which will immediately detect lurking genius in the most improbable disguises. One of the axioms that will lie at the foundation of the future science will probably be expressed in some such formula as this, that the one real virtue is *force*, though it may appear in many manifestations. Mr. Herbert Spencer maintains that the laws of every phenomenon throughout the universe, including all spiritual and intellectual, as well as physical, phenomena, may be ultimately stated as corollaries from the primary laws of *force*. By applying the principle of the conservation of forces, we discover that the fall of a given weight through a given distance is equivalent to the development of a given quantity of heat. In like manner we should discover that the same *force* when converted into intellectual activity will generate a given quantity of poetry or philosophy. And, conversely, we may compare the merit of two literary productions by determining how much *force* was consumed in their production. If, for example, Shakspeare's brain did an amount of work equal to ten foot-pounds in composing the soliloquy of Hamlet, and Goethe's did an amount equal to five of the

NOTE 10.
Saturday
Review.

same units in composing Mignon's song in *Wilhelm Meister*, then the merit of the soliloquy is precisely double that of the song. We lay no particular stress on this theory, which has, as some people may fancy, a rather materialist sound, but it may serve as an illustration of our proposed principle. To compare the merits of any two writers, decide which exhibits the greater amount of *force*, and, as a rule, you may safely pronounce him to be the greater.

The *energy* which in one case displays itself by a strong grasp of a few leading principles displays itself in the other by overlaying them with a vast variety of illustrations and applications. The same amount of intellectual power may be displayed in Swift's attack upon Wood's copper coinage, and in Burke's on a regicide peace. Swift's power appears in the kind of bull-dog tenacity with which he throttles his antagonists; and Burke's in the versatility with which he perplexes them by every conceivable mode of assault. To decide which is the greater, we must wait for that new calculus of the future which will enable us to estimate the total expenditure of *force* in either case. Hasty critics, as a rule, happen to find one variety of expression more congenial to them than the other, and fail to observe that it is a question, not of the essential *power*, but of the mode of application. In some cases a concentration, and in others a diffusion, of *force* may be most appropriate; and it is a great, though a very common, mistake to apply the same measure to all.

NOTE 11.

On Causes and Remedies of Disease which are not material and therefore cannot produce their effects by being absorbed by the vessels of the body.

I. HEAT A CAUSE OF DISEASE.

- | | |
|--------------------------------|---|
| Of Diarrhœa. | DR. WM. L. EDGAR. <i>St. Louis Med. and Surg. Journal</i> . Sept. 1871, and DR. FARR, quoted by SIR T. WATSON, vol. ii. p. 517, 4th edit. |
| „ Fever. | E. LONG FOX, M.D. <i>Medical Times</i> , Feb. 5, 1870. |
| „ Nervous Apoplexy. | DR. L. P. YANDELL, in <i>Report of Louisville Coll. of Phys. and Surg.</i> |
| „ Aphonia. | ABERCROMBIE, quoted by FRED. BATEMAN, M.D. <i>Practitioner</i> , April, 1869. |
| „ Hemiplegia. | FRED. BATEMAN, M.D. <i>Practitioner</i> , April, 1869, p. 110. |
| „ Insanity. | A LATE INMATE OF GARTNAVEL ASYLUM. <i>Philosophy of Insanity</i> , p. 19. MacLachlan and Stewart. 1860. |
| „ Parenchymatous Degeneration. | DR. WICKHAM LEGG. <i>Path. Soc.</i> , May 6, 1873, quoted in <i>Brit. Med. Journal</i> , May 31, 1873. |

2. HEAT, A REMEDY OF DISEASE.

Of Diarrhœa.

DR. R. WEISER. *Wien. Med. Wochenschrift*. No.
35, 1871.

,, Scarlatina.

,, Croup.

,, Bronchitis.

3. ELECTRICITY A CAUSE OF DISEASE.

Of Palsy.

RISTELHUNTER. *Journal de Bas Rhin*, quoted
in FLETCHER'S *Pathology*, edited by DRYSDALE
and RUSSELL. Vol. i. p. 58. Mac-
lachlan and Stewart. 1842.

,, Gravel.

Ditto.

,, Laryngitis.

SAMUEL. "The Trophic Nerves," quoted by
Pract., Feb., 1873.

,, Pneumonia.

Ibid.

,, Eczema.

From Pulvermacher's chain, *Pract.*

4. ELECTRICITY A REMEDY OF DISEASE.

Of Chorea.	DR. ALTHAUS. <i>Medical Times</i> , May 25, 1861, and DR. MANCA. <i>The Doctor</i> , Dec. 1872.
„ Paralysis Agitans.	DR. U. S. L. BUTLER. <i>Practitioner</i> . Nov. 1869.
„ Erysipelas.	DR. SYCIANKO of Charkow, Russia. BERLIN. <i>Klin. Wochensch</i> , 1870.
„ Herpes Zoster.	M. PICOT. <i>Gazette des Hopitaux</i> , 96. 1870.
„ Chilblains.	DR. CANCATO. <i>The Doctor</i> , Dec. 1872.
„ Arthritis.	DR. WEISFOG. <i>Ibid.</i>
„ Ileus.	DR. MACARIO. <i>Ibid.</i>
„ Cephalalgia.	DR. MANCA. <i>Ibid.</i>
„ Neuralgia.	DR. MANCA. <i>Ibid.</i>
„ Asthma.	DR. MANCA. <i>Ibid.</i>
„ Conjunctivitis granular.	DR. TREUHART. <i>New York Medical Record</i> , Dec. 16, 1872, quoted by <i>Practitioner</i> , June 1873, p. 397, and DR. RIDOFFI, -quoted in <i>The Doctor</i> , Dec. 1872, and SCHIVARDI, <i>Central Zeitung</i> , July 31, 1872, quoted in <i>The Doctor</i> , June 1, 1873.
„ Neuroma after amputation.	GIRARD.
„ Tetanus.	DR. PECK of Chicago in Report on Medical Electricity in <i>Doctor</i> , No. iv.
„ Cramps of Cholera.	„ „ „
„ Glaucoma.	„ „ „
„ Lupus.	„ „ „
„ Chronic Rheumatism.	DR. PRINCE. <i>Ibid.</i>
„ Rheumatic Gout.	DR. ALTHAUS.
„ Gouty Chalk Stones.	DR. ALTHAUS.
„ Local Paralysis.	DR. BOUCHUT of Paris.
„ Graves' Disease.	DUSCH also EULENBERGH and GUTTMAN in <i>Die Pathologie des Sympathicus</i> .
„ Bronchocele.	MORITZ MEYER.
„ Tumour of Tonsils similar to scirrhus.	MR. MAUNDER and MR. J. ADAMS. <i>Medical Times</i> , Jan. 25, 1873.
„ Angina Pectoris.	DR. BEARD. <i>Philad. Med. and Surg. Rep.</i> , May 11, 1872.

Of Writer's Palsy.

DR. T. BUZZARD of London, of Paralytic Hospital, and DR. G. V. POORE, of Charing Cross Hospital. *Practitioner*.

„ Carcinoma and Cancer.

DR. NEFTEL of New York, quoted by M. BENEDIKT of VIENNA. *Wiener Medizinisch Presse*, No. 53, Jahrgang xii.

5. DISEASE OF ONE PART CAUSE OF DISEASE OF OTHER.

Cauterization of a secreting surface } causes Bronchitis and Pneumonia and Syncope.

W. E. JEFFREYS and J. HAINWORTH. *Med. Times*, April 14, 1871.

Burn of Surface

Ulceration of Duodenum. SIR THOMAS WATSON. *Practice of Phys.*, 2 vols. p. 452, of 4th edit.

Scarlatina

„ Carditis, Pericarditis.

J. J. RIDGE. *Med. Times*, Sept. 2, 1871.

Disease of one eye

„ Ophthalmia of other.

DR. ARGYLL ROBERTSON. *Med. Chir. Soc.*, Feb. 7, 1872, and DR. MOOREN of Berlin, and DR. OGLESBY in *Brit. Med. Journal*, April 26, 1873; and DR. TILLAUX of the Hôpital St. Louis, and DR. ROSEBRUGH of Canada, *The Doctor*, June, 1873, p. 124.

Scarlatina	causes Rheumatism. TROUSSEAU, quoted by J. J. RIDGE. <i>Med. Times</i> , Sept. 2, 1871, p. 272.
Pericarditis	„ Convulsion of Diaphragm. DR. BRIGHT. A case in 1834, mentioned in <i>Practitioner</i> , April, 1869.
Fatigue of muscles	„ Lepra. ERASMUS WILSON on <i>Lepra-alphos</i> , p. 265, <i>Journal of Cutaneous Medicine</i> .
Worms in intestines	„ Aphonia. DR. BROWN-SEQUARD, and DR. GILSON of Hull, quoted by FRED. BATEMAN. <i>Practitioner</i> , April, 1869, p. 109.
Parturition	„ Pityriasis. ERASMUS WILSON on <i>Cutaneous Statistics</i> , p. 261, <i>Four. Cutaneous Medicine</i> .
Piles	„ Neuralgia of heel. H. LEE of St. George's, in <i>Lectures on Practical Pathology and Surgery</i> .
Neuralgia of anterior crural nerve.	„ Ekzema. GEO. GASKOIN of Brit. Hosp. for Dis. of Skin, in <i>Brit. Med. Journal</i> , April 19, 1873.

6. INJURY OR IRRITATION—CAUSE OF DISEASE OF DISTANT PART.

Tritis	Conjunctivitis	caused by	Division of Trifacial nerve.					
			SCHIFF, quoted by H. POWER. <i>Practitioner</i> , March, 1873.					
Syncope		„ „	Cramp of legs.					
			AUTHOR.					
Nausea and Eructation		„ „	Rupture of Heart.					
			J. DE BARRY of Frankfort. <i>Deutsch Archiv.</i> <i>G. Clin. Med.</i> , Feb., 1870, p. 152, quoted in <i>Report on Path. and Med.</i> , 1870, p. 541.					
Epilepsy		„ „	Injury to a nerve.					
			C. WESTPHAL of Vienna. <i>The Doctor</i> .					
Palsy of arms		„ „	Scald of Legs.					
			JOHN DUNCAN of Edinburgh, on Herpes Zoster, p. 245, in <i>Journal of Cutaneous</i> <i>Medicine</i> .					
Zymosis		„ „	Injury to Spine.					
			DR. BINZ's pamphlet quoted in <i>Practitioner</i> , August, 1868.					
Aphonia		from	Injury to finger.					
			T. LAYCOCK of Edinburgh.					
Aphasia		„	Paracentesis Abdominis.					
			DR. GUERIN of Hotel Dieu quoted in <i>The</i> <i>Doctor</i> , Jan. 1873.					
Sneezing		„	Pulling hair from nose.					
„		„	Sudden exposure to sun-light.					
			SPENCER WATSON. <i>Practitioner</i> , April, 1873, p. 219.					
Vomiting		„	Irritation of fauces.					
„		„	Disgust.					
			DR. MITCHELL.					
„		„	Compression of Vagus.					
			A. WALLER, in <i>Practitioner</i> , April, 1870, p. 200.					
Pneumonia		„	Injury to brain.					
			BROWN-SEQUARD. <i>The Doctor</i> , Feb., 1871.					
Pulmonary Apoplexy		„	„	„	„	„	„	„
Œdema		„	„	„	„	„	„	„
Emphysema		„	„	„	„	„	„	„

Laryngitis	from Irritation of nerves.
Pneumonia	„ „ of vagi. SAMUEL, quoted by H. POWER in <i>Practitioner</i> of February, 1873.
Nephritis	„ External injury. <i>Medical Times</i> , Dec. 2, 1865, on Nephritis.
Rheumatism	„ Passing a bougie. J. J. RIDGE. <i>Medical Times</i> , Sept. 2, 1871, p. 274.
Œdema of lungs, Emphysema	„ Injury to pons varolii. BROWN-SEQUARD. <i>The Doctor</i> , Feb., 1871.
Pneumonia	„ Injury to brain. BROWN-SEQUARD. <i>Ibid.</i>
Ekzema	„ Wound of nerve. WOAKES on neurotic exanthemata in <i>Journal</i> of <i>Cutaneous Medicine</i> , p. 281, case 21.
Erythema	„ Wound of nerves. DR. EDIS.
Roseola	
Urticaria	
Pemphigus	
Herpes	from Neuralgia, G. GASKOIN.
Ekzema	„ <i>Brit. Med. Jour.</i> , April 10, 1873.
Acne	„ DR. EDIS.
Ulcers of fingers	from Division of median nerve. M. GILLETTI and BROCA quoted in <i>Practitioner</i> , February, 1873.
Diabetes	„ Injury of fourth ventricle. WILSON FOX and ECKHARD, quoted in <i>Report</i> on <i>Physiology</i> , p. 189.
„	„ Severe mental strain. DR. RICHARDSON quoted by Edit. of <i>Brit. and</i> <i>For. Med. Chir. Rev.</i> , July, 1873, p. 117.
Tuberculosis	„ Cotton-thread under the skin. WILSON FOX, BURDON SANDERSON, and ANDREW CLARK.
Purpura Hæmorrhagia	„ Blow on cheek. DR. CAVAFY of St. George's. <i>The Doctor</i> , July, 1871.
Mania	„ Ascaris in Œsophagus. M. LAURENT of Marseilles Asylum. <i>Report</i>

- on the Progress of Psychological Medicine,*
July, 1869, p. 295.
- Paralysis of epiglottis from Pressure on abdomen.
DR. CHAIROND of Milan. *Gaz. Med. Ital.*
Lom., quoted by *Doctor*.
- Hemiplegia „ Sudden cessation of fit of gout.
DR. PARRY of Bath, quoted by Sir T. WATSON.
Pract. Physic, vol. ii., p. 765 of 4th edit.
- Orchitis Cessation of fits of gout. DR RECORD of Cin-
cinnati.
- Gastritis
- Arachnitis
- Convulsions of whole body „ Irritation of nostrils.
HARVEY, quoted by R. BARNES, M.D., of St.
Thomas's. *Brit. Med. Journ.*, April 19, 1873.
- Tetanus „ From injury to toe.
„ Wound of sole of foot.
„ Foreign body in foot.
DR. EBEN WATSON of Glasgow. *Practitioner*,
Jan., 1870, and Sept., 1869; and DR.
CEPHAS L. BARD. *Western Lancet*, July, 1872.
- Eczema „ Cessation of Meningitis. W. A. HAMMOND,
M.D. of New York. *Brit. Med. Journal*,
June 14, 1873, p. 666.

7. IRRITATION CURE OF DISEASE OF DISTANT PART.

Lupus		cured by	Fit of gout. T. L. MILTON, Surgeon to St. John's. <i>Journal of Cutaneous Medicine</i> , vol. ii., No. 8.
Rheumatism of heart	„ „		Compression of vagi. DR. AUGUSTUS WALLER, F.R.S.
Hemicrania periodical	„ „		Compression of vagi. DR. AUGUSTUS WALLER, F.R.S. <i>Practitioner</i> , p. 205. Art. on <i>Compression of vagus nerve</i> .
Ulcers of leg	„ „		Division of popliteal nerve. HOOKER. <i>Lancet</i> , 1859.
Neuralgia trifacial	„ „		Cauterization of lobe of ear. A. TROUSSEAU, <i>Clinical Medicine</i> , vol. i. p. 510, of Syd. Soc.
Herpes Zoster	„ „		Blister on opposite side. DR. I. K. SPENDER of Bath. <i>Practitioner</i> , 1870. <i>Notes and Queries</i> , p. 255.
Enlarged glands	„ „		Erysipelas. M. MALAPEZ, quoted in <i>Doctor</i> , Dec. 1872.
„ „	„ „		Large and distant blister. FURNEAUX JORDAN. New method of treating surgical diseases. <i>Practitioner</i> .
Tinea Circinata	„ „		Erysipelas. DR. H. S. PURDON.
„ „	„ „		Fever. DR. H. S. PURDON, Belfast. <i>Doctor</i> , May, 1873.
Pleurisy	„ „		Blister down the arm of same side. FURNEAUX JORDAN. Article on new method of treating surgical diseases. <i>Practitioner</i> , p. 80.

8. PASSION CAUSE OF DISEASE.

Sudoresis	caused by	Fright.
Diarrhœa	„ „	Fright. Sir THOS. WATSON, vol. ii, p. 516 of 4th edit.
Aphasia	„ „	Anger. DR. T. DUDGEON. <i>Report of Peking Hospital</i> , quoted in <i>Medical Times</i> , April 27, 1872.
Collapse like that from poisoning }	from	Fright. FAYRER on the action of the Cobra poison. <i>Edin. Med. Journal</i> , June, p. 1100.
Bloody Sudoresis	„	Fright. PAULINI, quoted by SCHNEIDER in <i>Journal of Mental Science</i> , 1870, p. 269.
Lepra } Alphos }	„	Fright. E. WILSON. <i>Four. Cut. Med.</i> Art. on Lepra- alphos, p. 264.
Psoriasis	„	Emotion. DR. BALMANNO SQUIRE. <i>Brit. Med. Jour.</i> , March 22, 1873. On Etiology of Psoriasis.
Vitiligoidea	„	Fright. ADDISON.
Asthma	„	Fright. H. H. SALTER, M.D. <i>On Asthma, its Pathology and Treatment</i> , 1868.
Paralysis	„	Fright. Prof. LAURA of Turin. Mental anxiety. WATSON, vol. i., p. 702.
Diarrhœa in infant }	„	Fright to mother.
Convulsions in „ }	„	RIDGE. <i>Med. Times</i> , Sept. 2, 1871, p. 273.
Fever and Delirium	„	Joy. DR. C. H. JONES. <i>Four. Mental Science</i> , July, 1870.
Insanity	„	Joy. Prof. GRIESINGER. <i>Four. Ment. Science</i> , July, 1870.
African Fever	„	Depressing emotion,

	BAKER. <i>Medical Times</i> , quotation from <i>Baker's Journal</i> , October 17, 1863.
Rapid death	from Depressing emotion. D. de BRANDT HOVEL and MR. CHAS. NIXON, <i>Path. Soc.</i> , Dublin, February 22, 1873.
Fatal Anæmia	„ Depressing emotion. SAM. WILKS of Guy's. <i>Med. Times</i> , Jan. 11, 1868.
Palsy	„ Depressing emotion. <i>Aretæus</i> , Book i., p. 308, of Syd. Soc. translation, and W. A. HAMMOND of New York, in <i>Treatise on Diseases of Nervous System</i> .
Indigestion	„ Depressing emotion. SAM. WILKS of Guy's.
Anorexia	„ Depressing emotion. SAM. WILKS of Guy's, and A. MITCHELL on <i>Sympathetic Insanity</i> , quoted by <i>Edin. Med. Jour.</i> Dec., 1871, p. 492, and TRISTRAM SHANDY, gent. vol. v., cap. 10, <i>Uncle Toby's apologetical oration</i> .
Suppression of milk	„ Depressing emotions. J. P. DICKSON of St. Luke's, in a paper read in April, 1870, before the Med. Soc. of London.
Aphonia	„ Excitement. TODD. <i>Clinical Lectures on Diseases of Brain</i> , p. 278, and <i>Dun's Medical Psychology</i> , p. 77, and DR. PANTHEL of Limburgh.
Yawning	„ Imitation.
Chorea	„ „
Hysteria	„ „
Flow of saliva	„ From hunger and emotion at sight of food. A. MITCHELL. <i>Edin. Med. Jour.</i> , Dec., 1871, p. 492.
Vomiting	„ Disgust. A. MITCHELL. <i>Edin. Med. Jour.</i> , Dec., 1871, p. 492.
Jaundice	„ Emotion. SAM. WILKS of Guy's. <i>Med. Times</i> , Jan. 11, 1868.
„	„ Fright. DR. BENICE JONES. 1869.
Cerebral hæmorrhage	„ Vexation. HAMMOND of New York.

Pityriasis	from Nervous shock. ERASMUS WILSON, in <i>Four. Cut. Med.</i> , p. 262. Art. on Cutaneous Statistics.
Starting, or spasm of voluntary muscles	} „ Surprise. FLETCHER.
Horripilation	„ Eating sour apple. FLETCHER.
Secretion of milk	„ Maternal affection. A. MITCHELL. <i>Edin. Med. Jour.</i> , Dec., 1871, p. 492.
Tetanus	„ Fright. DR. HENNEN, and DR. WILLAN. <i>Cyclo. Pract. Med.</i> , vol. iv., p. 674.
Fatal Cholera	„ Depressing emotions. Prof. LAURA of Turin, in <i>Med. Times</i> , Feb. 15, 1868.
Epilepsy	„ Emotion. Quoted in <i>Brit. and For. Med. Chir. Rev.</i> , July, 1873, p. 117.
Erysipelas	„ Sympathy. MARSHALL HALL, quoted in <i>Brit. and For. Med.</i> <i>Chir. Rev.</i> , July, 1873, p. 122.
Writer's Cramp	„ Emotion. DR. G. V. POORE. <i>Practitioner</i> , July, 1873, p. 8 & 10.
Chlorosis	„ Violent emotion. T. SPENCER WELLS, on <i>Diseases</i> <i>of Ovaries</i> p. 119 of edit. of 1872, and DRS. DUCKWORTH and LAYCOCK. <i>Brit. Med. Journal</i> , Aug. 23, 1873.
Graves' Disease	„ Violent emotion. DR. DUCKWORTH. <i>Ibid.</i>
Rupture of Uterus	„ Violent emotion. JOS. MITCHELL. <i>Brit. and For.</i> <i>Med. Chir. Rev.</i> , Jan., 1871, p. 51.

9. PASSION—CURE OF DISEASE.

Rheumatism	cured by	Fright. D. H. TUKE. <i>Field</i> newspaper.
Asthma	„ „	Fright. DR. SALTER. <i>On Asthma its Pathology and Treatment</i> , 1868.
Scurvy	„ „	Joy. Report of American Surgeons during the late war.
Collapse and Syncope	} „ „	Joy. FAYRER on the action of the cobra poison. <i>Edin.</i> <i>Med. and Surg. Jour.</i> , June, p. 1100, (1871?).
Contraction of limb	} caused by	Emotion. CHARCOT & BRIQUET, quoted in <i>The Doctor</i> , July 1, 1872.
Ague	„ „	Emotion. BLOWER of Bedford. <i>Lancet</i> , Nov. 2, 1872.
Most diseases remedied by		Faith and hope. LAYCOCK. <i>Observation and Research</i> , p. 136, 1864.

10. COLD A CAUSE OF DISEASE.

- Of Bronchitis - J. J. RIDGE. *Medical Times*, Sept. 16, and Aug. 26, 1871.
- „ Cozyra DR. WILLIAMS and Sir T. WATSON, vol. ii., p. 29, 4th edit.
- „ Catarrh T. MACKINTOSH of Edinburgh, vol. i., p. 371, 3rd edit., 1832. Longmans, Rees & Co. Sir T. WATSON, vol. ii, p. 27, 4th edit.
- „ Pneumonia J. J. RIDGE and Editor of *Med. Times*, Dec. 2, 1871.
- „ Pleurisy J. J. RIDGE and Editor of *Med. Times*, Dec. 2, 1871.
- „ Carditis J. J. RIDGE *Med. Times*, August 26, 1871.
- „ Pericarditis J. J. RIDGE *Med. Times*, August 26, 1871.
- „ Enteritis J. J. RIDGE.
- „ Gastritis Sir T. WATSON, vol. ii., p. 428, 4th edit.
- „ Peritonitis DR. J. J. RIDGE. *Med. Times*, August 26, 1871.
- „ Nephritis Editor of *Med. Chir. Rev.*, 299, April, 1872, p. 429, and DR. DICKENSON, *Med. Chir. Rev.*, March, 1868, p. 835, and *Med. Times*, Dec. 2, 1865, and Sir T. WATSON, *Practical Physic*, vol. ii., p. 684, 4th edit.
- „ Cystitis. G. JOHNSON of King's College. *Brit. Med. Journal*, May 31, 1873, p. 606.
- „ Metritis. W. ALLAN JAMIESON, M.B. of Berwick upon Tweed. *Edin. Med. Journal*, Nov., 1870, p. 405.
- „ Meningitis Cerebral. DR. J. J. RIDGE. *Medical Times*, Aug. 26, 1871.
- „ Meningitis Spinal. } DR. W. STRANGE of Worcester. *Medical Times*,
 „ Myelitis. } Oct. 12, 1872, p. 403.
- „ Neuritis. Edit. *Med. Chir. Rev.*, No. 299, and DR. LOCKHART CLARKE in Holmes' *System of Surgery*, art. "Nerve Lesions."
- „ Iritis.
- „ Sclerotitis. J. J. RIDGE. *Medical Times*, August 26, 1871, p. 247.
- „ Rheumatism. J. J. RIDGE, M.D. *Medical Times*, August 26, 1871, p. 248.
- „ Gout. J. J. RIDGE, M. D. *Medical Times*, Sept. 2, 1871, p. 274.

- Of Rheumatic Gout. Dr. ROBERT ADAMS. quoted in *Edin. Med. Journal*, June, 1873, p. 1111.
- „ Lepra. ERASMUS WILSON. in *Journal Cut. Med.*, p. 265, Art. ERASMUS WILSON, on *Lepa Alphos*.
- „ Alphos. ERASMUS WILSON. p. 265 of *Journal Cut. Med.*
- „ Herpes. WOAKES and DR. J. J. RIDGÉ. *Medical Times*, August 26, 1871.
- „ Erythema. DR. J. J. RIDGÉ. *Medical Times*, Sep. 2, 1871, p. 274.
- „ Furunculus. HEBRA on *Diseases of Skin*. Vol. 1, p. 350.
- „ Jaundice. SYDNEY RINGER of University College Hospital. *Medical Times*, Jan. 18, 1868, p. 62.
- „ Tetanus. DR. J. A. SYMONDS of Bristol in *Cyclo. Pract. Med.* 4th vol., p. 672, and ARETÆUS. Chap. 6, p. 247 of Syd. Soc.
- „ Aphasia. JACKSON of Philadelphia. DR. BANKS. DR. ABERCROMBIE, quoted in *Practitioner*, April, 1869, p. 109.
- „ Neuralgia. WOAKES and DR. J. J. RIDGÉ. *Medical Times*, Sep. 16, 1871, p. 344, and SAMUEL CRADDOCK of Shepton Mallet. *Practitioner*, June 1873, p. 338.
- „ Hæmaturia, DR. ED. H. GREENHOW of Middlesex Hospital. On Intermittent or Paroxysmal Hæmaturia, *Med. Chir. Rev.*, 1868,
- „ Paralysis. DR. J. J. RIDGÉ. *Medical Times*, Sep. 16, 1871, p. 344. SIR THOMAS WATSON. Vol. i, p. 702, 4th edit.
- „ Necrosis of Jaw. WOAKES on Neurotic Exanthema, *Practitioner*, p. 281,
- „ Necrosis.
- „ Œdema Pedum. SYDNEY RINGER, M.D. *Med. Times*, Jan. 18, 1868. p. 63.
- „ Congestion of Liver. Edit. of *Medical Times*, Dec. 2, 1871.
- „ Abscess. C. F. MAUNDER, Surgeon to London Hospital. *Medical Times*, Sep. 23, 1871. "Clinical Lecture."
- „ Dropsy, MR. FRED. TAYLOR. *Medical Times*, Oct. 14, 1871. "Case of Acute Dropsy without Albuminuria."

- Of Chorea. ROGER and STEINER. *Centralblatt f. d. Med. Wissenschaften*. July 9, 1870, quoted in Report on Pathology, *Med. Chir. Rev.*, 1871, p. 549.
- „ Epidemic Diarrhœa. J. WATSON of Southern Manchooria. *Edin. Med. Jour.*, Nov., 1869.
- „ Diarrhœa. DR. THOROWGOOD of Clin. Soc. London. *Brit. Med. Jour.* May 31, 1873, and SIR T. WATSON. p. 535, vol. 2, 4th edit.
- „ Palsy of Capillaries. Sir J. PAGET, *Doctor*, Dec., 1871.
- „ Sleep. DR. COURAN. Medical History of the Himalayas, as quoted in the *Doctor*, as a Novel Hypnotic.
- „ Bright's Disease. G. JOHNSON of King's College. *Brit. Med. Jour.*, Feb. 15, 1873, and June 21, p. 696. SIR THOS. WATSON, Vol. 2, p. 716, 4th edit.
- „ Essential Paralysis. BOUCHUT of Paris.
- „ Ophthalmic Zona. M. HYBORD of Brussels. *Press. Med. Belg.* quoted by the *Doctor*, May 1, 1873.
- „ Myalgic affections. Edit. of *Practitioner*, June, 1873, p. 354.

II. COLD A REMEDY OF DISEASE.

- Of Arachnitis. DR. LAMBERT of Brussels. *Journal de Med. de Bruxelles*.
- „ Typhus Fever. MOSLER of Berlin, quoted in *Union Medicale*. DR. RIEGEL. *Alt. Wien. Med. Ztg.*, quoted in *Doctor*, p. 65. DR. BRAND.
- „ Typhoid Fever. DR. LAMBERT of Brussels. *Journal de Med. de Bruxelles*, quoted report in *Brit. and For. Journal*, p. 313.
- „ Fever and Delirium. CURRIE and STRAUS of Strasburgh. *Med. Chir. Rev.*, June, p. 1138.
- „ Rheumatic Fever. DR. SYDNEY RINGER of University Coll. Hos., in *Practitioner*, Feb., 1873, p. 75.
- „ Surgical Fever. T. SIMON of St. Thomas', Surgeon. *Brit. Med. Jour.*, May 10, 1873.
- „ Scarlet Fever. C. Pittz and Currie.
- „ Articular Rheumatism. DR. ESMARCH of Strasburgh.
- „ Apoplexy. as of door key to spine—ice-bag. CHAPMAN.
- „ Epistaxis. DR. CHAPMAN. *The Doctor*, Feb., 1871.
- „ Vomiting. DR. DYCE DUCKWORTH. (Ice between Scapulæ) *Practitioner*.
- „ Hæmoptysis. DR. PARRY of Bath, quoted by SIR T. WATSON. *Pract. Phys.*, vol. 2, p. 765, 4th edit.
- „ Gout. CAZENAVE of Bordeaux. *Journal de Med. et de Chir.*, May, 1871, quoted in the *Doctor*, June, 1871.
- „ Tympanitis. DR. CHAPMAN. *The Doctor*, Feb., 1871.
- „ Ague. DR. AUGUSTUS WALLER, F.R.S., quotes patient who fell from his house into canal, in *Pract.*, p. 206, art. "Compression of Vagus Nerve," and PROF. MOSLER.
- „ Asphyxia. BAILLIE. *Indian Med. Gazette*, 2871, Sep. 1.
- „ Nausea. DR. CHAPMAN. *The Doctor*, Feb., 1871.
- „ Hyperpyrexia. DR. STRAUS of Strasburgh. *Bulletin. Gen. Ther. Med. Chir.*, March, 1872, quoted, *Med. Chir. Rev.*, June, p. 1138.

Of Ataxy.	CURRIE and DR. STRAUS.
„ Collapse.	„ „
„ Conjunctivitis.	HAYNES WALTON, Surgeon to St. Mary's. Lectures delivered in a course of Ophthalmic Instruction.
„ Diarrhœa.	CHAPMAN. DRUITT.
„ Neuralgia.	
„ Hypertrophy of Spleen.	Prof. MOSLER of Greifswalde. <i>Edin. Med. Jour.</i> , July, 1873, p. 83.
„ Narcosis from Chloroform	} (ice in rectum) DR. BAILLIE, quoted in <i>Practitioner</i> , June 1873, p. 389.

"Others, I doubt not, if not we,
 The issue of our toils shall see;
 Boy-students gather as their own,
 The harvest that the dead have sown,
 The dead forgotten and unknown."

